Technical Notes for the Current Employment Statistics Survey

Introduction

The Bureau of Labor Statistics (BLS) collects data each month on employment, hours, and earnings from a sample of nonfarm establishments through the Current Employment Statistics (CES) program. The CES survey includes about 145,000 businesses and government agencies, which cover approximately 557,000 individual worksites drawn from a sampling frame of Unemployment Insurance (UI) tax accounts covering roughly 9 million establishments. The active CES sample includes approximately one-third of all nonfarm payroll employees in the 50 States and the District of Columbia. From these data, a large number of employment, hours, and earnings series in considerable industry and geographic detail are prepared and published each month. Historical statistics for the Nation are available on the CES National website at www.bls.gov/ces/data.htm. Historical statistics for States and metropolitan areas are available on the CES State and metropolitan area website at www.bls.gov/sae/data.htm.

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The Sample

Design

The Current Employment Statistics (CES) sample is a stratified, simple random sample of worksites, clustered by Unemployment Insurance (UI) account number. The UI account number is a major identifier on the Bureau of Labor Statistics (BLS) Longitudinal Database (LDB) of employer records, which serves as both the sampling frame and the benchmark source for the CES employment estimates. The sample strata, or subpopulations, are defined by State, industry, and employment size, yielding a State-based design. The sampling rates for each stratum are determined through a method known as optimum allocation, which distributes a fixed number of sample units across a set of strata to minimize the overall variance, or sampling error, on the primary estimate of interest. The Total nonfarm employment level is the primary estimate of interest, and the CES sample design gives top priority to measuring it as precisely as possible, or minimizing the statistical error around the National Total nonfarm employment estimates.

Frame and sample selection. The LDB is the universe from which CES draws the establishment survey sample. The LDB contains data on the roughly 9 million U.S. business establishments covered by UI, representing nearly all elements of the U.S. economy. The [Quarterly Census of Employment and Wages](#) (QCEW) program collects these data from employers on a quarterly basis in cooperation with Labor Market Information Agencies (LMIs). The LDB contains employment and wage information from employers, as well as name, address, and location information. It also contains identification information such as UI account number and reporting unit or worksite number.

The LDB contains records of all employers covered under the UI tax system. That system covers 97 percent of all employment within the scope of CES in the 50 States, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands. There are a few sections of the economy that are not covered by the QCEW, including the self-employed, unpaid family workers, railroads, religious organizations, small agricultural employers, and elected officials. Data for employers generally are reported at the worksite level. Employers who have multiple establishments within a State usually report data for each individual establishment. The LDB tracks establishments over time and links them from quarter to quarter.

The Total private and Government portions of the CES sample are selected using two different methods. Private establishments in the CES sample frame are stratified by State, industry, and size. Stratification groups population members together for the purpose of sample allocation and selection. The strata, or groups, are composed of homogeneous units. With 13 industries (see [Table 5,](#) treating Manufacturing as one industry and not including Government) and 8 size classes (see [Table 2](#)), there are 104 total allocation cells per State. The sampling rate for each stratum is determined through a method known as optimum allocation. Optimum allocation minimizes variance at a fixed cost or minimizes cost for a fixed variance. Under the CES probability design, a fixed number of sample units for each State is distributed across the allocation strata in such a way as to minimize the overall variance, or sampling error, of the total State employment level. The number of sample units in the CES probability sample was fixed according to available program resources. The optimum allocation formula places more sample

in cells for which data cost less to collect, cells that have more units, and cells that have a larger variance.

The CES Government sample is not part of the program's probability-based design. CES is able to achieve a very high level of universe employment coverage in Government industries by obtaining full payroll employment counts for many government agencies, eliminating the need for a probability-based sample design. Government estimates are combined with the Total private estimates to obtain values for Total nonfarm.

In the fall of each year, a new sample is drawn from that year's first quarter LDB data. Annual sample selection helps keep the CES survey current with respect to employment from business births and business deaths (see Birth/Death Model). In addition, the updated universe files provide the most recent information on industry, size, and metropolitan area designation. About a full year separates the sample draw and the sample implementation to allow time for enrollment and collection of selected units. Enrollment of the selected units begins immediately following the sample draw and collection begins immediately following enrollment. Preliminary estimates for January through December 2013 will be made using the sample selected from the 2011 LDB data.

After all out-of-scope records are removed, the sampling frame is separated into allocation cells. Within each allocation cell, units are grouped by metropolitan statistical area (MSA), and these MSAs are sorted by the size of the MSA, defined as the number of UI accounts in that MSA. As the sampling rate is uniform across the entire allocation cell, implicit stratification by MSA ensures that a proportional number of units are sampled from each MSA. Some MSAs may have too few UI accounts in the allocation cell; these MSAs are collapsed and treated as a single MSA.

Permanent Random Numbers (PRNs) are assigned to all UI accounts on the sampling frame. As new units appear on the frame, random numbers are assigned to those units as well. As records are linked across time, the PRN is carried forward in the linkage. Within each selection cell, the units are sorted by PRN, and units are selected according to the specified sample selection rate. The number of units selected randomly from each selection cell is equal to the product of the sample selection rate and the number of eligible units in the cell plus any carryover from the prior selection cell. The result is rounded to the nearest whole number. Carryover is defined as the amount that is rounded up or down to the nearest whole number.

As a result of the cost and workload associated with enrolling new sample units, all units remain in the sample a minimum of two years. To ensure all units meet this minimum requirement, CES has established a "swapping in" procedure. The procedure allows units to be swapped into the sample that were newly selected during the previous sample year and not reselected as part of the current probability sample. The procedure removes a unit within the same selection cell and places the newly selected unit from the previous year back into the sample. Approximately 68 percent of the CES sample for the private industries overlaps from the previous sample to the current sample.

Selection weights. Once the sample is drawn, sample selection weights are calculated based on the number of UI accounts actually selected within each allocation cell. The sample selection weight is approximately equal to the inverse of the probability of selection, or the inverse of the sampling rate. It is computed as:

Equation 1. Sample selection weights

$$\text{Sample selection weight} = N_h / n_h$$

where:

N_h = the number of noncertainty UI accounts within the allocation cell that are eligible for sample selection

n_h = the number of noncertainty UI accounts selected within the allocation cell

Frame maintenance and sample updates. Due to the dynamic economy, there is a constant cycle of business openings (births) and closings (deaths). A semi-annual update is performed during the summer each year drawing from the previous year's third quarter LDB data. This update selects units from the population of openings and other units not previously eligible for selection and includes them as part of the sample. Location, contact, and administrative information are updated for all establishments that were selected as part of the annual sample.

Coverage

Table 1 shows the latest benchmark employment levels and the approximate proportion of total universe employment coverage at the Total nonfarm and major industry sector (see Table 5) levels. The coverage for individual industries within the supersectors may vary from the proportions shown.

CES sample by industry. The sample distribution by industry reflects the goal of minimizing the sampling error in the Total nonfarm employment estimate, while also providing reliable employment estimates by industry. Sample coverage rates vary by industry as a result of building a design to meet these goals (See Table 1). For example, Manufacturing and Leisure and hospitality industries are of similar size. Manufacturing has about 11.8 million employees while Leisure and hospitality has 13.3 million employees. However their relative sample sizes are different. Manufacturing has about 18,800 sample units with a total of 3 million employees while Leisure and hospitality has many more sample units, about 62,300 sample units but covers only about 2.6 million employees. The Manufacturing sample therefore covers about 25 percent of all employment in Manufacturing while the Leisure and hospitality sample covers about 19 percent of all employment in that industry. The differences are linked in part to the fact that Manufacturing is characterized by a much larger average firm size than Leisure and hospitality. These types of differences do not cause a bias in the CES employment estimates because of the use of industry sampling strata and sampling weights which ensure each firm is properly represented in the estimates.

Government sample. The CES Government sample is not part of the program's probability-based design, which is used to estimate employment for all Private industries. A very high level of universe employment coverage (75 percent) is achieved by obtaining full payroll employment counts for many government agencies, thus a probability-based sample design is not necessary for this industry. The high coverage rate virtually assures a high degree of reliability for the Government employment estimates. Because it is used to estimate only the Government portion of Total nonfarm employment, the large Government sample does not bias the Total nonfarm employment estimates. The Private and Government estimates are summed to derive Total nonfarm employment estimates.

Table 1. Employment benchmarks and approximate coverage of CES employment and payrolls sample, March 2012 [1]

CES Industry Code	CES Industry Title	Employment Benchmarks (in thousands)	Sample coverage			
			Unemployment Insurance counts (UI)[2]	Number of establishments	Employees	
					Number (in thousands)[3]	Percent of benchmark employment level
00-000000	Total nonfarm	132,505	140,874	494,621	42,020	32
10-000000	Mining and logging	836	1,112	2,578	185	22
20-000000	Construction	5,313	10,641	12,875	542	10
30-000000	Manufacturing	11,822	10,046	18,758	3,001	25

CES Industry Code	CES Industry Title	Employment Benchmarks (in thousands)	Sample coverage			
			Unemployment Insurance counts (UI)[2]	Number of establishments	Employees	
					Number (in thousands)[3]	Percent of benchmark employment level
40-000000	Trade, transportation, and utilities	25,082	21,425[4]	140,744	6,752	27
50-000000	Information	2,672	2,673	14,982	709	27
55-000000	Financial activities	7,726	6,874	55,251	1,719	22
60-000000	Professional and business services	17,601	21,189	52,111	3,310	19
65-000000	Education and health services	20,377	17,346	51,071	6,037	30
70-000000	Leisure and hospitality	13,334	16,980	62,264	2,582	19
80-000000	Other services	5,394	6,511	15,214	378	7
90-000000	Government	22,348	27,582	68,777	16,804	75

[1]Formerly Table 2-Ca.

[2]Counts reflect active sample reports. Because not all establishments report payroll and hours information, hours and earnings estimates are based on a smaller sample than are the employment estimates.

[3] Employment of reported values for March 2011.

[4] The Surface Transportation Board provides a complete count of employment for Class I railroads plus Amtrak. A small sample is used to estimate hours and earnings data.

CES sample by employment size class. The employment universe that the CES sample is estimating is highly skewed as shown in Table 2. The largest UI accounts comprise only 0.2 percent of all UI accounts but contain approximately 28 percent of Total private employment. Therefore, it is very efficient to sample these UIs with certainty — by sampling only 0.2 percent of the UIs, the survey can cover 28 percent of total private universe employment. Conversely the smallest size class (0-9 employees) contains nearly 71 percent of all UIs but only about 11 percent of Total private employment; therefore it is efficient to sample these UIs at a much lower rate. Sampling larger firms at a higher rate than smaller firms is a standard technique commonly used in business establishment surveys.

Table 2. Total private universe employment by size of UI, March 2011[1]

Size Class	Percent of All UIs	Percent of Employment
1 (0-9 employees)	71	10.5
2 (10-19 employees)	13.7	7.9
3 (20-49 employees)	9.1	12.2
4 (50-99 employees)	3.2	9.9
5 (100-249 employees)	1.9	13.4
6 (250-499 employees)	.6	9.6
7 (500-999 employees	.3	9
8 (1000+ employees)	.2	27.5
Total	**100**	**100**

[1]Formerly Table 2-Cb.

Table 3 shows the distribution of the active CES sample units. A much greater proportion of large than small UIs are selected; however that does not create a bias in either the sample or the estimates made from the sample. Each sample unit selected is assigned a weight based on its probability of selection, which ensures that all firms of its size are properly represented in the estimates. UIs with a large number of employees are selected with certainty and assigned a weight of one, meaning they represent only themselves in the estimates. Conversely, a UI in the smallest firm stratum where 1 in every 100 firms are selected is assigned a weight of 100, because it represents itself and 99 other firms that were not sampled. The use of sample weights in the estimation process prevents a large (or small) firm bias in the estimates.

Table 3. Total private CES sample employment by size of UI, March 2011[1]

Size Class	Percent of All Sample UIs	Percent of Sample Employment
1 (0-9 employees)	27.4	0.3
2 (10-19 employees)	13.1	.6
3 (20-49 employees)	16.3	1.7
4 (50-99 employees)	11.1	2.7
5 (100-249 employees)	12.8	6.9

Size Class	Percent of All Sample UIs	Percent of Sample Employment
6 (250-499 employees)	7.6	9.6
7 (500-999 employees)	6	15.8
8 (1000+ employees)	5.7	62.4
Total	**100**	**100**

[1]Formerly Table 2-Cc.

Reliability

Measurements of error. The establishment survey, like other sample surveys, is subject to two types of error, sampling and nonsampling error. The magnitude of sampling error, or variance, is directly related to the size of the sample and the percentage of universe coverage achieved by the sample. The establishment survey sample covers over one-third of total universe employment; this yields a very small variance on the Total nonfarm estimates. Measurements of error associated with sample estimates are provided in Table 4 and the all employee (AE), production employee (PE), and women employee (WE) standard error tables.

Table 4. Errors of preliminary employment estimates [1]

CES Industry Code	CES Industry Title	Root-Mean-Square Error of Monthly Level[2]	Mean Percent Revision	
			Actual	**Absolute**
00-000000	**Total nonfarm**	72,600	0.0	0.0
05-000000	**Total private**	39,600	.0	.0
90-000000	**Government**	47,200	.0	.2
90-910000	**Federal**	8,800	.0	.2
90-911000	**Federal, except U.S. Postal Service**	8,300	.0	.2
90-919120	**U.S. Postal Service**	3,900	-.1	.1
90-920000	**State government**	20,900	.1	.3
90-921611	**State government education**	20,000	.3	.6
90-922000	**State government, excluding education**	6,000	.0	.2
90-930000	**Local government**	34,600	.0	.2
90-931611	**Local government education**	34,300	.0	.3
90-932000	**Local government, excluding education**	7,400	.0	.1

[1] Formerly Table 2-D.

[2]The root-mean-square error is the square root of the mean squared error. The mean squared error is the square of the difference between the final and preliminary estimates averaged across a series of monthly observations.

NOTE: Errors are based on differences for the months January through October of years 2008 to 2012.

Benchmark revision as a measure of survey error. The sum of sampling and nonsampling error can be considered total survey error. Unlike most sample surveys which publish sampling error as their only measure of error, the CES can derive an annual approximation of total error, on a lagged basis, because of the availability of the independently derived universe data. While the benchmark error is often used as a proxy measure of total error for the CES survey estimate, it actually represents the difference between two employment estimates derived from separate statistical processes (i.e., the CES sample process and the UI administrative process) and thus reflects the net of the errors present in each program. Historically, the benchmark revision has been small for Total nonfarm employment. Over the past decade, absolute percentage benchmark error has averaged 0.3 percent, with an absolute range from 0.1 percent to 0.7 percent. Further discussion about the CES annual benchmark can be found in the Revisions section of this document under Benchmarks.

Revisions between preliminary and final data. First preliminary estimates of employment, hours, and earnings, based on less than the total sample, are published immediately following the reference month. Final revised sample-based estimates are published two months later when nearly all the reports in the sample have been received. Table 4 presents the root-mean-square error, the mean percent, and the mean absolute percent revision over the past five years between the preliminary and final employment estimates.

Revisions of preliminary hours and earnings estimates are normally not greater than 0.1 of an hour for weekly hours and 1 cent for hourly earnings, at the Total private level, and may be slightly larger for the more detailed industry groupings. Further discussion about the CES sample-based monthly revisions to estimates can be found in the Revisions section of this document under Sample-based Revisions.

Variance estimation. The estimation of sample variance for AE, PE, and WE for the CES survey is accomplished through use of the method of Balanced Half Samples (BHS). This replication technique uses half samples of the original sample and calculates estimates using those subsamples. The sample variance is calculated by measuring the variability of the subsample estimates. The weighted link estimator is used to calculate both estimates and variances. The sample units in each cell — where a cell is based on State, industry, and size classification — are divided into two random groups. The basic BHS method is applied to both groups. The subdivision of the cells is done systematically, in the same order as the initial sample selection. Weights for units in the half sample are multiplied by a factor of $1 + \gamma$ where weights for units not in the half sample are multiplied by a factor of $1 - \gamma$. Estimates from these subgroups are calculated using the estimation formula described above.

The formula used to calculate CES variances is as follows:

Equation 2. CES variance

$$v_k^+\left(\hat{\theta}\right) = \frac{1}{\gamma^2 k}\sum_{\alpha=1}^{k}\left(\hat{\theta}_\alpha^+ - \hat{\theta}\right)^2 ,$$

where

$\hat{\theta}_\alpha^+ = \theta\left(\hat{Y}_\alpha^+, \hat{X}_\alpha^+, \ldots\right)$ is the half-sample estimator

$\gamma = \frac{1}{2}$

k is the number of half samples

$\hat{\theta}$ is the original full-sample estimate.

Appropriate uses of sampling variances. Variance statistics are useful for comparison purposes, but they do have some limitations. Variances reflect the error component of the estimates that is due to surveying only a subset of the population, rather than conducting a complete count of the entire population. However, they do not reflect nonsampling error, such as response errors, and bias due to nonresponse. The variances of the over-the-month change estimates are very useful in determining when changes are significant at some level of confidence. Variance statistics for first and second closings are available for AE, PE, and WE. In addition, third closing variances are available upon request.

Sampling errors. The sampling errors shown for all Private industries and Total nonfarm have been calculated for estimates that follow the benchmark employment revision by a period of 16 to 20 months. The errors are presented as median values of the observed error estimates. These estimates have been estimated using the method of BHS with the probability sample data and sample weights assigned at the time of sample selection.

Illustration of the use of relative standard error tables. AE, PE, and WE standard error tables provide a reference for relative standard errors of all major series developed from the CES. The standard errors of differences between estimates in two non-overlapping industries are calculated as

Equation 3. CES relative standard error

$$S_{Diff} = \sqrt{S_1^2 + S_2^2} \qquad \text{because the two estimates are independent.}$$

The errors are presented as relative standard errors (standard error divided by the estimate and expressed as a percent). Multiplying the relative standard error by its estimated value gives the estimate of the standard error.

Suppose that the level of all employees for Financial activities in a given month at first closing is estimated at 7,819,000. The approximate relative standard error of this estimate (0.5 percent) is provided in the AE, PE, and WE standard error tables. A 90-percent confidence interval would then be the interval:

$$7,819,000 \pm (1.645 \times .005 \times 7,819,000) = 7,819,000 \pm 64,311 = 7,754,689 \text{ to } 7,883,311$$

Illustration of the use of standard error tables. AE, PE, and WE standard error tables provide a reference for the standard errors of 1-, 3-, and 12-month changes in the employment, hours, and earnings series. The errors are presented as standard errors of the changes. Suppose that the over-the-month change in all employee average hourly earnings (AHE) from January to February in Coal mining at second closing is $0.11. The standard error for a 1-month change for Coal mining from the table is $0.34. The interval estimate of the over-the-month change in AHE that will include the true over-the-month change with 90-percent confidence is calculated:

$$\$0.11 \pm (1.645 \times \$0.34) = \$0.11 \pm \$0.56 = [-\$0.45, \$0.67]$$

The true value of the over-the-month change is in the interval -$0.45 to $0.67. Because this interval includes $0.00 (no change), the change of $0.11 shown is not significant at the 90-percent confidence level. Alternatively, the estimated change of $0.11 does not exceed $0.56 (1.645 * $0.34); therefore, one could conclude from these data that the change is not significant at the 90-percent confidence level.
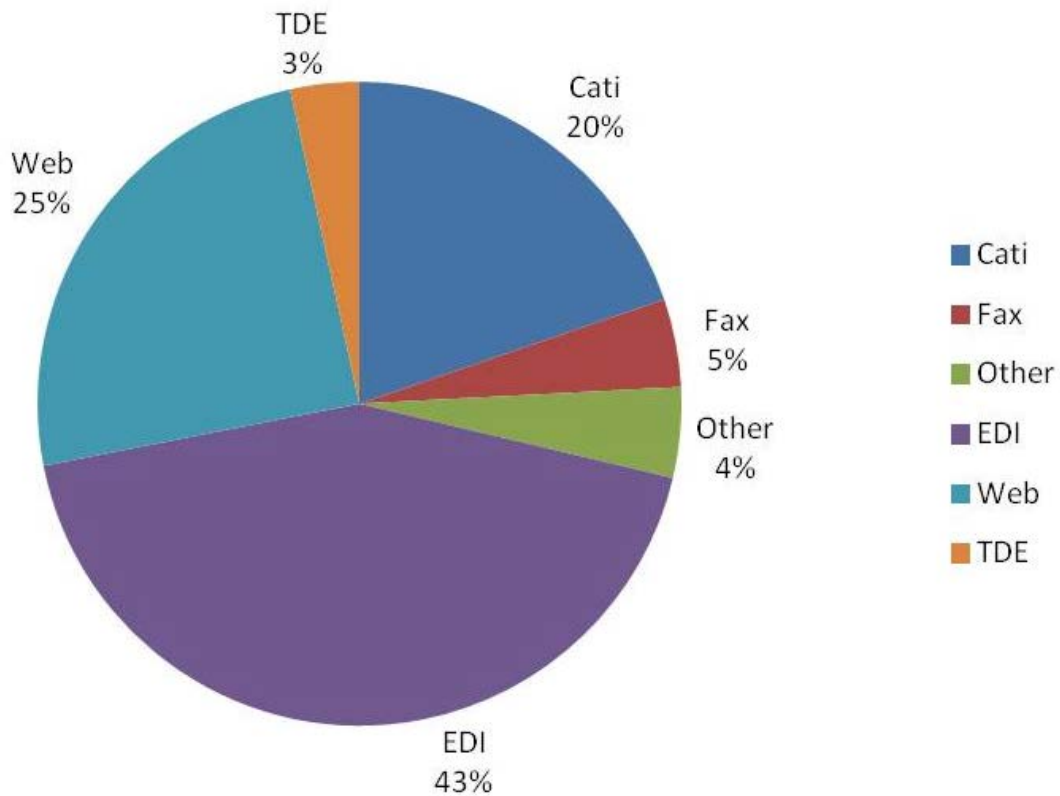
Data Collection

Collection Methods

Each month, the Bureau of Labor Statistics (BLS) collects data on employment, payroll, and paid hours from a sample of establishments. Prior to 1991, most of the Current Employment Statistics (CES) sample was collected by mail in a decentralized environment by each Labor Market Information Agency (LMI). CES has gradually centralized collection and adopted automated sample collection methods with the result that collection rates have gradually risen over time. Now, CES has a comprehensive program of new sample unit solicitation in four CES Regional Data Collection Centers (DCCs). The DCCs perform initial enrollment of each firm via telephone, collect the data for several months via Computer Assisted Telephone Interviewing (CATI), and where possible transfer respondents to a self-reporting mode such as Touchtone Data Entry (TDE), fax, or Internet collection. In addition, the DCC's conduct an ongoing program of refusal conversion. Very large firms are often enrolled via personal visit and ongoing reporting is established via Electronic Data Interchange (EDI). Offering survey respondents a choice of reporting methods helps sustain response rates to this voluntary survey. The largest portion of the CES sample is collected via EDI (43 percent), while Internet collection and CATI are used to collect approximately 25 percent and 20 percent of all reports, respectively. Under EDI, the firm provides an electronic file to CES each month in a prescribed file format. This file includes data for all of the firm's worksites. The file is received, processed, and edited by the CES operated EDI Center. Internet collection is one of the fastest growing collection methods. Under Internet collection, the respondent links to a secure website that contains an image of the questionnaire and enters their data into the on-line form. The data are subject to a series of edit checks before being transmitted to CES.

TDE, another self-reporting mode, is used to collect about 3 percent of the monthly reports. Under the TDE system, the respondent uses a touchtone telephone to call a toll-free number and activate an interview session. The questionnaire resides on the computer in the form of prerecorded questions that are read to the respondent. The respondent enters numeric responses by pressing the touchtone phone buttons. Each answer is read back for respondent verification.

Fax collection through the combined Regional CES DCCs account for most of the remainder of the reports (5 percent). For the few establishments that do not use the above methods, data are collected using mail, transcript, magnetic tape, or computer diskette (4 percent).

Figure 1 shows the percentage of the establishments using different data collection methods.

Figure 1. CES data collection methods by percent [1]

[1]Formerly Chart 1.

Collection Forms

The CES collection forms are separated by broad industry group and number of pay groups. Each form asks of an establishment how often employees receive pay, if they receive commissions and how often, and the total number of employees, production employees, women employees, payroll, commission, and hours. This list of questions is repeated for each month in a twelve month period; a new form is required for the next twelve month period. Respondents receive a booklet with space to complete these questions.

A complete list of CES report forms is available here, www.bls.gov/ces/idcfcesforms.htm.

Classification

Industry Classification

All data on employment, hours, and earnings for the Nation, States, and metropolitan areas are classified in accordance with the North American Industry Classification System (NAICS) 2012, specified by the U.S. Office of Management and Budget (OMB). The U.S., Canada, and Mexico share this classification system, which allows a direct comparison of economic data across the three countries. For information about the use of NAICS in the Current Employment Statistics (CES) program, see www.bls.gov/ces/cesnaics.htm.

Establishments are classified into industries on the basis of their primary activity. Those that use comparable capital equipment, labor, and raw material inputs are classified together. This information is collected as a supplement to the quarterly Unemployment Insurance (UI) tax reports filed by employers. For an establishment engaging in more than one activity, the entire employment of the establishment is included under the industry indicated by the principal activity.

Major Industry Groups

CES aggregates estimates for detailed industries into 1 of 17 major industry sectors. Major industry sectors are defined in Table 5 below. All major industry sectors include only privately-owned establishments, except for 90-910000 Federal government, 90-920000 State government, and 90-930000 Local government.

Table 5. Major industry sectors [1]

CES Industry Code	Major Sector Name	NAICS Codes Included / Ownership
10-000000	Mining and logging	1133, 21 / Private
20-000000	Construction	23 / Private
31-000000	Durable goods manufacturing	33, 32 [2] / Private
32-000000	Nondurable goods manufacturing	31, 32 [2] / Private
41-420000	Wholesale trade	42 / Private
42-000000	Retail trade	44-45 / Private
43-000000	Transportation and warehousing	48-49 / Private
44-220000	Utilities	22 / Private
50-000000	Information	51 / Private
55-000000	Financial activities	52,53 / Private
60-000000	Professional and business services	54,55,56 / Private
65-000000	Education and health services	61,62 / Private
70-000000	Leisure and hospitality	71,72 / Private

CES Industry Code	Major Sector Name	NAICS Codes Included / Ownership
80-000000	Other services	811,812,813 / Private
90-910000	Federal government	All in-scope NAICS / Federal government
90-920000	State government	All in-scope NAICS / State government
90-930000	Local government	All in-scope NAICS / Local government

[1] Formerly Table 1.

[2] CES allocates 3-digit NAICS industries to this major industry sector based on industry description.

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Aggregate industry sectors group the major industry sectors into higher levels of detail, as defined in Table 6 below.

Together, the major industry and aggregate industry sectors are referred to as supersectors.

Table 6. Aggregate industry sectors [1]

CES Industry Code	Aggregate Sector Name	Sectors Included
00-000000	Total nonfarm	05-000000 Total private, 90-000000 Government
05-000000	Total private	06-000000 Goods-producing, 08-000000 Private service-providing
06-000000	Goods-producing	10-000000 Mining and logging, 20-000000 Construction, 30-000000 Manufacturing
07-000000	Service-providing	40-000000 Trade, transportation, and utilities, 50-000000 Information, 55-000000 Financial activities, 60-000000 Professional and business services, 65-000000 Education and health services, 70-000000 Leisure and hospitality, 80-000000 Other services, 90-000000 Government
08-000000	Private service-providing	40-000000 Trade, transportation, and utilities, 50-000000 Information, 55-000000 Financial activities, 60-000000 Professional and business services, 65-000000 Education and health services, 70-000000 Leisure and hospitality, 80-000000 Other services
30-000000	Manufacturing	31-000000 Durable goods, 32-000000 Nondurable goods
40-000000	Trade, transportation, and utilities	41-420000 Wholesale trade, 42-000000 Retail trade, 43-000000 Transportation and warehousing, 44-220000 Utilities
90-000000	Government	90-910000 Federal government, 90-920000 State government, 90-930000 Local government

[1] Formerly Table 2.

Available Data

National data availability. The Current Employment Statistics (CES) program produces nonfarm employment series for all employees (AE), production and nonsupervisory employees (PE), and women employees (WE). For AE and PE, CES also produces average hourly earnings (AHE), average weekly hours (AWH), and, in Manufacturing industries only, average weekly overtime hours (AWOH). Most employment series begin in 1990, although employment by aggregate industry sector and most major industry sectors is published as far back as 1939.

Over 2,200 not seasonally adjusted employment series for AE, PE, and WE are published monthly. The series for AE include over 900 industries at various levels of aggregation.

Approximately 2,700 AE and PE series for AHE, AWH, and, in Manufacturing, AWOH are published monthly on a not seasonally adjusted basis and cover about 600 industries.

About 4,700 seasonally adjusted employment, hours, and earnings series for AE, PE, and WE are published.

Over 6,400 not seasonally adjusted special derivative series such as average weekly earnings (AWE), indexes, and constant dollar series for AE and PE are also published for approximately 600 industries.

State and area data availability. For States and metropolitan areas, the CES program produces nonfarm industry employment, hours, and earnings series for AE and PE. Most employment series begin in 1990. Metropolitan areas are defined by the U.S. Office of Management and Budget (OMB). Further information about State and metropolitan area data is available in the Statistics for States and Areas section of this document.

Employment

Employment data refer to persons on establishment payrolls who worked or received pay for any part of the pay period that includes the 12th day of the month.

The data exclude proprietors, the unincorporated self-employed, unpaid volunteer or family employees, farm employees, and domestic employees. Salaried officers of corporations are included. Government employment covers only civilian employees; military personnel are excluded. Employees of the Central Intelligence Agency, the National Security Agency, the National Imagery and Mapping Agency, and the Defense Intelligence Agency also are excluded.

Persons on establishment payrolls who are on paid sick leave (for cases in which pay is received directly from the firm), on paid holiday, or on paid vacation, or who work during a part of the pay period even though they are unemployed or on strike during the rest of the period are counted as employed. Not counted as employed are persons who are on layoff, on leave without

pay, or on strike for the entire period, or who were hired but have not yet reported during the period.

Production and nonsupervisory employees (PE) are defined differently for certain major industry sectors. In Manufacturing and in Mining and logging, PE includes only production and related employees. In Construction, PE includes only Construction employees. In Private service-providing industries, PE includes all nonsupervisory employees. These distinctions are clarified below.

Production and related employees. This category includes working supervisors and all nonsupervisory employees (including group leaders and trainees) engaged in fabricating, processing, assembling, inspecting, receiving, storing, handling, packing, warehousing, shipping, trucking, hauling, maintenance, repair, janitorial, guard services, product development, auxiliary production for plant's own use (for example, power plant), recordkeeping, and other services closely associated with the above production operations.

Construction employees. This group includes the following employees in the construction sector: working supervisors, qualified craft employees, mechanics, apprentices, helpers, laborers, and so forth, engaged in new work, alterations, demolition, repair, maintenance, and the like, whether working at the site of construction or in shops or yards at jobs (such as precutting and preassembling) ordinarily performed by members of the construction trades.

Nonsupervisory employees. These are employees (not above the working-supervisor level) such as office and clerical employees, repairers, salespersons, operators, drivers, physicians, lawyers, accountants, nurses, social employees, research aides, teachers, drafters, photographers, beauticians, musicians, restaurant employees, custodial employees, attendants, line installers and repairers, laborers, janitors, guards, and other employees at similar occupational levels whose services are closely associated with those of the employees listed.

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Hours and Earnings

Concurrent with the release of January 2010 data, the CES program began publishing all employee hours and earnings as official BLS series. These series were developed to measure the AHE and AWH of all nonfarm private sector employees and the AWOH of all Manufacturing employees. AE hours and earnings were first released as experimental series in April 2007, and included National level estimates at a Total private sector level and limited industry detail.

Historically, the CES program has published average hours and earnings series for production employees in the Goods-producing industries and for non-supervisory employees in the Service-providing industries. These employees account for about 80 percent of Total private nonfarm employment. The AE hours and earnings series are more comprehensive in coverage, covering 100 percent of all paid employees in the private sector, thereby providing improved information for analyzing economic trends and for constructing other major economic indicators, including nonfarm productivity and personal income.

AE average hours and earnings data are derived from reports of hours and payrolls for all employees. PE average hours and earnings data are derived from reports of production and related employees in Manufacturing and Mining and logging, construction employees in Construction, and nonsupervisory employees in Private service-providing industries.

Hours. These are the hours worked or for which pay was received during the pay period that includes the 12th of the month for all employees, production, construction, and nonsupervisory employees. Included are hours paid for holidays, for vacations, and for sick leave when pay is received directly from the firm.

Payroll. Payroll refers to dollars paid for full- and part-time all employees, production, construction, and nonsupervisory employees who received pay for any part of the pay period that includes the 12th day of the month. The payroll is reported before deductions of any kind, such as those for old-age and unemployment insurance, group insurance, withholding tax, bonds, or union dues; also included is pay for overtime, tips, holidays, and vacation and for sick leave paid directly by the firm. Excluded from the payroll are bonuses (unless earned and paid regularly each pay period); other pay not earned in the pay period reported (such as retroactive pay); and the value of free rent, fuel, meals, or other payment in kind. Commissions are also included if paid at least monthly.

Overtime hours. These are hours worked by all employees, production and related employees, and nonsupervisory employees in Manufacturing for which overtime premiums were paid because the hours were in excess of the number of hours of either the straight-time workday or the workweek during the pay period that included the 12th of the month. Weekend and holiday hours are included only if overtime premiums were paid. Hours for which only shift differential, hazard, incentive, or other similar types of premiums were paid are excluded.

Average weekly hours. The workweek information relates to the average hours for which pay was received and is different from standard or scheduled hours. Such factors as unpaid absenteeism, labor turnover, part-time work, and stoppages cause average weekly hours to be lower than scheduled hours of work for an establishment. Industry supersector averages further reflect changes in the workweek of component industries.

Average hourly earnings. Average hourly earnings are on a "gross" basis. They reflect not only changes in basic hourly and incentive wage rates, but also such variable factors as premium pay for overtime and late-shift work and changes in output of employees paid on an incentive plan. They also reflect shifts in the number of employees between relatively high-paid and low-paid work and changes in employees' earnings in individual establishments. Averages for groups and divisions further reflect changes in AHE for individual industries.

Averages of hourly earnings differ from wage rates. Earnings are the actual return to the employee for a stated period; rates are the amount stipulated for a given unit of work or time. The earnings series do not measure the level of total labor costs on the part of the employer because the following are excluded: Benefits, irregular bonuses, retroactive items, payroll taxes paid by employers, and earnings for those employees not covered under production employee, construction employee, or nonsupervisory employee definitions.

Average overtime hours. Overtime hours represent that portion of weekly hours that exceeded regular hours and for which overtime premiums were paid in the Manufacturing sector. If an employee were to work on a paid holiday at regular rates, receiving as total compensation his holiday pay plus straight-time pay for hours worked that day, no overtime hours would be reported. This applies to both AE and PE average overtime hours.

Because overtime hours are premium hours by definition, weekly hours and overtime hours do not necessarily move in the same direction from month to month. Such factors as work stoppages, absenteeism, and labor turnover may not have the same influence on overtime hours as on average hours. Diverse trends at the industry group level also may be caused by a marked change in hours for a component industry in which little or no overtime was worked in both the previous and current months.

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Derivative Series

Average weekly earnings. These estimates are derived by multiplying AWH estimates by AHE estimates. Therefore, AWE are affected not only by changes in AHE but also by changes in the length of the workweek. Monthly variations in such factors as the proportion of part-time employees, stoppages for varying reasons, labor turnover during the survey period, and absenteeism for which employees are not paid may cause the average workweek to fluctuate.

Long-term trends of AWE can be affected by structural changes in the makeup of the workforce. For example, persistent long-term increases in the proportion of part-time employees in Retail trade and many of the services industries have reduced average workweeks in these industries and have affected the average weekly earnings series.

Real earnings. These earnings are in constant dollars and are calculated from the earnings averages for the current month using a deflator. The [Consumer Price Index](#) (CPI) for All Urban Consumers (CPI-U) is used to deflate the earnings series for AE, while the CPI for Urban Wage Earners and Clerical employees (CPI-W) is used to deflate the earnings series for PE. The scope for the CPI-W is similar to that of PE earnings, both in the type of worker which is covered and the amount of the population that is covered by these series. The CPI-U used to deflate AE earnings is more inclusive than the CPI-W. Since AE earnings include all Private sector employees the more inclusive deflator is used in the calculation. The reference base for the CPI series is the 36-month period covering the years 1982, 1983, and 1984.

For more information about real earnings, see www.bls.gov/news.release/realer.tn.htm.

Average hourly earnings, excluding overtime. Average hourly earnings, excluding overtime-premium pay, are produced for Manufacturing only and are computed by dividing the total AE or PE payroll for the industry group by the corresponding sum of total AE or PE hours and one-half of total AE or PE overtime hours. No adjustments are made for other premium payment provisions, such as holiday pay, late-shift premiums, and overtime rates other than time and one-half.

Indexes of aggregate weekly hours and payrolls. For basic estimating industries, aggregate hours are the product of AWH for AE times the employment for AE or AWH for PE times the employment for PE. At all higher levels of industry aggregation, aggregate hours are the sum of the component aggregates. The indexes for AE aggregate weekly hours are calculated by dividing the current month's aggregate by the average of the 12 monthly figures for 2007. The indexes of aggregate weekly hours for PE are calculated by dividing the current month's aggregate by the average of the 12 monthly figures for 2002.

For basic industries, the aggregate payroll is the product of AHE for AE and aggregate weekly hours for AE or AHE for PE and aggregate weekly hours for PE. At all higher levels of industry aggregation, aggregate payroll is the sum of the component aggregates. The indexes of aggregate weekly payrolls are calculated by dividing the current month's aggregate by the average of the 12 monthly figures for 2007 for AE and 2002 for PE.

Indexes of diffusion of employment change. Diffusion indexes measure the dispersion of employment change across industries over a specified time span (1-, 3-, 6-, or 12-month). The overall indexes are calculated from 266 seasonally adjusted employment series (primarily 4-digit NAICS industries) covering nonfarm payroll employment in the private sector. The Manufacturing diffusion indexes are based on 81 4-digit NAICS industries.

To derive the indexes, each component industry is assigned a value of 0, 50, or 100 percent, depending on whether its employment showed a decrease, no change, or an increase, respectively, over the time span. The average value (mean) is then calculated, and this percent is the diffusion index number.

The reference point for diffusion analysis is 50 percent, the value indicating that the same number of component industries had increased as had decreased. Index numbers above 50 show that more industries had increasing employment and values below 50 indicate that more had decreasing employment. The margin between the percent that increased and the percent that decreased is equal to the difference between the index and its complement - that is, 100 minus the index. For example, an index of 65 percent means that 30 percent more industries had increasing employment than had decreasing employment (65-(100-65) = 30). However, for dispersion analysis, the distance of the index number from the 50-percent reference point is the most significant observation.

Although diffusion indexes commonly are interpreted as showing the percent of components that increased over the time span, the index reflects half of the unchanged components as well. (This is the effect of assigning a value of 50 percent to the unchanged components when computing the index.)

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Forms of Publication

The Employment Situation. Each month, usually three weeks after the reference period including the 12th of the month, CES releases The Employment Situation, which contains CES

National first preliminary (first closing) estimates of employment, hours, and earnings for all 3-digit NAICS series. The remaining series published by CES are released with the following month's Employment Situation. For a list of CES published series, see www.bls.gov/ces/cesseriespub.htm.

Real Earnings. Each month, coincident with the CPI release, CES releases Real Earnings, which contains earnings data indexed to the CPI. For more information about real earnings, see Real Earnings in this document or visit www.bls.gov/news.release/realer.tn.htm.

Other forms of publication. CES data are also available in the following forms of publication:

- Employment and Earnings Online
- CES Databases
- CES Highlights

Statistics for States and Areas

CES independently develops National and State and area employment, hours, and earnings series. Both sets of estimates are based on the same establishment reports; however, CES uses the full establishment survey sample to produce monthly National employment estimates, while CES uses only the State-specific portion of the sample to develop State employment estimates. CES area statistics relate to metropolitan areas. CES uses the most recent OMB Bulletin regarding statistical area definitions (OMB Bulletin No. 10-02 www.whitehouse.gov/sites/default/files/omb/assets/bulletins/b10-02.pdf) to define metropolitan statistical areas and metropolitan divisions. CES also produces area statistics for non-standard areas (areas which are not defined in the OMB Bulletin), noted at www.bls.gov/sae/saenonstd.htm. Changes in definitions are noted as they occur. Estimates for States and areas are produced using two methods. The majority of State and area estimates are produced using direct sample-based estimation. However, published area and industry combinations (domains) that do not have a large enough sample to support estimation using only sample responses have been estimated using modeling techniques. For more State and area employment (SAE) information please see the CES SAE home page at www.bls.gov/sae/home.htm.

State and area estimates use smaller amounts of sample by industry than the National industry estimates. This increases the error component associated with State and metropolitan level estimates. For this reason, aggregating State data to the National level will also sum this error component, resulting in different estimates of U.S. employment, hours, and earnings. Summed State level CES estimates should not be compared to National CES estimates.

Estimation Methods

Monthly Estimation

The Current Employment Statistics (CES) program uses a matched sample concept and weighted link relative estimator to produce employment, hours, and earnings estimates. These methods are described in Table 7 below. A matched sample is defined to be all sample members that have reported data for the reference month and the month prior. Excluded from the matched sample is any sample unit that reports that it is out-of-business and has zero employees. This aspect of the estimation methodology is more fully described below in the section on Birth/Death Model estimation.

Table 7. Summary of methods for computing industry statistics on employment, hours, and earnings estimates [1]

Employment, hours, and earnings	Basic estimating cell (industry, 6-digit published level)	Aggregate industry level (supersector and, where stratified, industry)	Annual average data
All employees	All employee estimate for previous month multiplied by weighted ratio of all employees in current month to all employees in previous month, for sample establishments that reported for both months, plus net birth/death model estimate.	Sum of all employee estimates for component cells.	Sum of monthly estimates divided by 12.
Average weekly hours of all employees	All employee hours divided by number of all employees.	Average, weighted by all employees, of the average weekly hours for component cells.	Annual total of aggregate hours (all employees multiplied by average weekly hours) divided by annual sum of all employees.
Average weekly overtime hours of all employees	All employee overtime hours divided by number of all employees.	Average, weighted by all employees, of the average weekly overtime hours for component cells.	Annual total of aggregate overtime hours (all employees multiplied by average weekly overtime hours) divided by annual sum of all employees.

Employment, hours, and earnings	Basic estimating cell (industry, 6-digit published level)	Aggregate industry level (supersector and, where stratified, industry)	Annual average data
Average hourly earnings of all employees	All employee payroll divided by all employee hours.	Average, weighted by aggregate hours, of the average hourly earnings for component cells.	Annual total of aggregate payrolls (all employees multiplied by weekly hours and hourly earnings) divided by annual aggregate hours.
Average weekly earnings of all employees	Product of all employee average weekly hours and all employee average hourly earnings.	Product of all employee average weekly hours and all employee average hourly earnings.	Sum of monthly all employee aggregate payrolls divided by the sum of monthly all employees.
Production or nonsupervisory employees, women employees	All employee estimate for current month multiplied by (1) weighted ratio of production or nonsupervisory employees to all employees in sample establishments for current month or (2) weighted ratio of women employees to all employees.	Sum of estimates of (1) production or nonsupervisory employees or (2) women employees for component cells.	Sum of monthly estimates divided by 12.
Average weekly hours of production or nonsupervisory employees	Production or nonsupervisory employee hours divided by number of production or nonsupervisory employees.	Average, weighted by production or nonsupervisory employment, of the average weekly hours for component cells.	Annual total of aggregate hours (production or nonsupervisory employment multiplied by average weekly hours) divided by annual sum of production employment .
Average weekly overtime hours of production or nonsupervisory employees	Production employee overtime hours divided by number of production employees.	Average, weighted by production employment, of the average weekly overtime hours for component cells.	Annual total of aggregate overtime hours (production employment multiplied by average weekly overtime hours) divided by annual sum of production employment.

Employment, hours, and earnings	Basic estimating cell (industry, 6-digit published level)	Aggregate industry level (supersector and, where stratified, industry)	Annual average data
Average hourly earnings of production or nonsupervisory employees	Total production or nonsupervisory employee payroll divided by total production or nonsupervisory employee hours.	Average, weighted by aggregate hours, of the average hourly earnings for component cells.	Annual total of aggregate payrolls (production or nonsupervisory employment multiplied by weekly hours and hourly earnings) divided by annual aggregate hours.
Average weekly earnings of production or nonsupervisory employees	Product of production employee average weekly hours and production employee average hourly earnings.	Product of production employee average weekly hours and production employee average hourly earnings.	Sum of monthly aggregate payrolls divided by the sum of monthly production employees.

[1]Formerly Table 2-A.

Stratification. The sample is stratified into 606 basic estimation cells for purposes of computing National all employee (AE) estimates. Estimating cell structures may differ for production and nonsupervisory employees (PE), women employees (WE), and hours and earnings for both AE and PE. Cells are defined primarily by detailed industry. In the Construction supersector, geographic stratification is also used. The estimation cells can be defined at the 3-, 4-, 5-, and 6-digit North American Industry Classification System (NAICS) level.

In addition to the estimation cells mentioned above, there are 37 independently estimated cells which do not aggregate to the summary cell levels.

Weighted link-relative technique. The estimator for the AE series uses the sample trend in the cell to move the previous level to the current-month estimated level. A model-based component is applied to account for the net employment resulting from business births and deaths not captured by the sample.

The basic formula for estimating AE is:

Equation 4. All employees

$$\hat{AE}_c = \left(\hat{AE}_p \times \frac{\sum_i \left(w_i \times ae_{c,i} \right)}{\sum_i \left(w_i \times ae_{p,i} \right)} \right) + (net\ birth\ death\ estimate)\ ,$$

where:

i = matched sample unit;

w_i = weight associated with the CES report;

$ae_{c,i}$ = current-month reported all employees;

$ae_{p,i}$ = previous-month reported all employees;

$\hat{AE}_c$ = current-month estimated all employees; and

$\hat{AE}_p$ = previous-month estimated all employees.

Weighted link and taper technique. The estimator used for all datatypes other than AE accounts for the over-the-month change in the sampled units, but also includes a tapering feature used to keep the estimates close to the overall sample average over time. The taper is considered to be a level correction. This estimator uses matched sample data; it tapers the estimate toward the sample average for the previous month of the current matched sample before applying the current month's change; and it promotes continuity by heavily favoring the estimate for the previous month when applying the numerical factors. Variables used in these equations are defined below Equation 7.

Current month estimate of PE is defined as:

Equation 5. Production and nonsupervisory emplyees

$$\hat{PW}_c = \left(\left(\hat{AE}_c - \sum_j ae_{c,j}^{*(PW)} \right) \times \hat{PWRATIO}_c \right) + \sum_j pw_{c,j}^* ,$$

where

$$\hat{PWRATIO}_c = \left(\alpha \times \hat{PWRATIO}_p \right) + \left(\beta \times \frac{\left(\sum_i w_i \times pw_{p,i} \right) - \left(\sum_j w_j \times pw_{p,j}' \right)}{\left(\sum_i w_i \times ae_{p,i} \right) - \left(\sum_j w_j \times ae_{p,j}'^{(PW)} \right)} \right) + \left(\left(\frac{\left(\sum_i w_i \times pw_{c,i} \right) - \left(\sum_j w_j \times pw_{c,j}' \right)}{\left(\sum_i w_i \times ae_{c,i} \right) - \left(\sum_j w_j \times ae_{c,j}'^{(PW)} \right)} \right) - \left(\frac{\left(\sum_i w_i \times pw_{p,i} \right) - \left(\sum_j w_j \times pw_{p,j}' \right)}{\left(\sum_i w_i \times ae_{p,i} \right) - \left(\sum_j w_j \times ae_{p,j}'^{(PW)} \right)} \right) \right)$$

for all $i \in$ I and $j \in$ J.

Current month estimate of women employees (WE)

Estimation of the series for WE is identical to that described for PE with the appropriate substitution of WE values for the PE values in the previous formulas.

Current month estimate of Hours and Earnings series

The same estimation formulas currently used for the published series on PE hours and earnings are used for the AE hours and earnings series. Within the formulas, simply substitute AE references for PE references.

Current month estimate of average weekly hours (AWH) is defined as:

Equation 6. Average weekly hours

$$\hat{AWH_c} = \alpha \times \hat{AWH_p} + \beta \times \left(\left(\frac{ \left(\frac{\left(\sum_i w_i \times wh_{p,i}\right) - \left(\sum_j w_j \times wh_{p,j}^{\bullet}\right)}{\left(\sum_i w_i \times pw_{p,i}\right) - \left(\sum_j w_j \times pw_{p,j}^{*(WH)}\right)} \right) \times \left(\hat{PW_p} - \sum_j pw_{p,j}^{*(WH)} \right) + \sum_j wh_{p,j}^{\bullet} }{ \hat{PW_p} } \right) +$$

$$\left(\left(\frac{ \left(\frac{\left(\sum_i w_i \times wh_{c,i}\right) - \left(\sum_j w_j \times wh_{c,j}^{\bullet}\right)}{\left(\sum_i w_i \times pw_{c,i}\right) - \left(\sum_j w_j \times pw_{c,j}^{*(WH)}\right)} \right) \times \left(\dot{PW_c} - \sum_j pw_{c,j}^{*(WH)} \right) + \sum_j wh_{c,j}^{\bullet} }{ \dot{PW_c} } \right) - \left(\frac{ \left(\frac{\left(\sum_i w_i \times wh_{p,i}\right) - \left(\sum_j w_j \times wh_{p,j}^{\bullet}\right)}{\left(\sum_i w_i \times pw_{p,i}\right) - \left(\sum_j w_j \times pw_{p,j}^{*(WH)}\right)} \right) \times \left(\dot{PW_p} - \sum_j pw_{p,j}^{*(WH)} \right) + \sum_j wh_{p,j}^{\bullet} }{ \dot{PW_p} } \right) \right)$$

for all $i \in$ I and $j \in$ J.

Current month estimate of average hourly earnings (AHE) is defined as:

Equation 7. Average hourly earnings

$$\hat{AHE}_c = \alpha \times \hat{AHE}_p + \beta \times \left(\cfrac{\left(\cfrac{\left(\sum_i w_i \times pr_{p,i} \right) - \left(\sum_j w_j \times \overset{\bullet}{pr}_{p,j} \right)}{\left(\sum_i w_i \times wh_{p,i} \right) - \left(\sum_j w_j \times wh_{p,j}^{*(PR)} \right)} \right) \times \left(\hat{WH}_p - \sum_j wh_{p,j}^{*(PR)} \right) + \sum_j \overset{\bullet}{pr}_{p,j}}{\hat{WH}_p} \right) +$$

$$\left(\left(\cfrac{\left(\cfrac{\left(\sum_i w_i \times pr_{c,i} \right) - \left(\sum_j w_j \times \overset{\bullet}{pr}_{c,j} \right)}{\left(\sum_i w_i \times wh_{c,i} \right) - \left(\sum_j w_j \times wh_{c,j}^{*(M)} \right)} \right) \times \left(\overset{\bullet}{WH}_c - \sum_j wh_{c,j}^{*(M)} \right) + \sum_j \overset{\bullet}{pr}_{c,j}}{\overset{\bullet}{WH}_c} \right) - \left(\cfrac{\left(\cfrac{\left(\sum_i w_i \times pr_{p,i} \right) - \left(\sum_j w_j \times \overset{\bullet}{pr}_{p,j} \right)}{\left(\sum_i w_i \times wh_{p,i} \right) - \left(\sum_j w_j \times wh_{p,j}^{*(M)} \right)} \right) \times \left(\overset{\bullet}{WH}_p - \sum_j wh_{p,j}^{*(M)} \right) + \sum_j \overset{\bullet}{pr}_{p,j}}{\overset{\bullet}{WH}_p} \right) \right)$$

for all $i \in I$ and $j \in J$,

where:

i = a matched CES report

I = the set of all matched CES reports

j = a matched CES report where the current month is atypical

J = the set of all matched CES reports where the current month is atypical (Note: J is a subset of I)

$\alpha = 0.9$

$\beta = 0.1$

w_i = weight associated with the CES report

$pw_{c,i}$ = current month reported production employees

$pw_{p,i}$ = previous month reported production employees

$pw^*_{c,j}$ = current month reported production employees, **atypical record**

$pw^*_{p,j}$ = previous month reported production employees, **atypical record**

$pw^{*(WH)}_{p,j}$ = current month reported production employees, **atypical <u>WH</u> record**

$pw^{*(WH)}_{p,j}$ = previous month reported production employees, **atypical <u>WH</u> record**

$\hat{PW}_{c,i}$ = current month estimated production employees

$\hat{PW}_{p,i}$ = previous month estimated production employees

$wh_{c,i}$ = current month reported weekly hours

$wh_{p,i}$ = previous month reported weekly hours

$wh^*_{c,j}$ = current month reported weekly hours, **atypical record**

$wh^*_{p,j}$ = previous month reported weekly hours, **atypical record**

$wh^{*(PR)}_{c,j}$ = current month reported weekly hours, **atypical <u>PR</u> record**

$wh^{*(PR)}_{p,j}$ = previous month reported weekly hours, **atypical <u>PR</u> record**

$\hat{WH}_{c,i}$ = current month estimated aggregate employee hours

$\hat{WH}_{p,i}$ = previous month estimated aggregate employee hours

$\hat{AWH}_{c,i}$ = current month estimated average weekly hours

$\hat{A\overset{\frown}{WH}}_{c,i}$ = previous month estimated average weekly hours

$pr_{c,i}$ = current month reported weekly payroll

$pr_{p,i}$ = previous month reported weekly payroll

$pr*_{c,j}$ = current month reported weekly payroll, **atypical record**

$pr*_{p,j}$ = previous month reported weekly payroll, **atypical record**

$\hat{AHE}_{c,i}$ = current month estimated average hourly earnings

$\hat{A\overset{\frown}{WH}}_{c,i}$ = previous month estimated average hourly earnings

Current month estimate of average weekly overtime hours (AWOH)

Estimation of average weekly overtime hours is identical to that described for AWH with the appropriate substitution of overtime hours values for the weekly hours values in the previous formula.

Residential and Nonresidential specialty trade contractors estimates. Residential and nonresidential employment estimates in Specialty trade contractors (NAICS 238) are produced as breakouts under the standard NAICS coding structure. Benchmarks for these series are developed from the Quarterly Census of Employment and Wages (QCEW) data and independent estimates for these series are made on a monthly basis and raked to the estimates produced under the standard structure to ensure that the sum of the Residential specialty trade contractors and Non-residential specialty trade contractors series is consistent with the published total for Specialty trade contractors at the 3-digit NAICS level.

The raking adjustment uses the following methodology:

Estimates are derived independently for the residential and nonresidential groups at the 4-digit NAICS level for each region. The regional estimates are rounded and summed to the 4-digit NAICS level for both the residential and non-residential groups. Within each 4-digit NAICS series, ratios of residential-to-total employment and nonresidential-to-total employment are calculated.

At the 4-digit NAICS level, the sum of the residential/nonresidential series is subtracted from the official industry-region cell structure total to determine the amount that must be raked. The total amount that must be raked is multiplied by the ratios to determine what percentage of the raked

amount should be applied to the residential group and what percentage should be applied to the nonresidential group.

Once the residential and nonresidential groups receive their proportional amount of raked employment, the two groups are aggregated again to the 4-digit NAICS level. At this point they are equal to the 4-digit NAICS total derived from the official industry-region cell structure. This raking process also forces additivity at the 3-digit NAICS level.

Only estimates of AE are made for the Residential and Nonresidential specialty trade contractor series. Estimates of construction employees, women employees, and hours and earnings are not produced.

Small Domain Model

The small domain model. The CES Small Domain Model (SDM) is a Weighted Least Squares model with two employment inputs: (1) an estimate based on available CES sample for that series, and (2) an Autoregressive Integrated Moving Average (ARIMA) projection based on trend from ten years of historical QCEW data. These two over-the-month change estimates are then weighted based on the variance of each of the estimates. This version of the SDM is used for National and State estimation of a small number of series with sampling limitations.

The SDM for metropolitan statistical areas (MSAs) consists of a weighted sum of three different relative over-the-month change estimates $\hat{L}_1$, $\hat{L}_2$, and $\hat{L}_3$, calculated from the two employment inputs. These three relative over-the-month estimates are then weighted based on the variance of each of the three estimates. The larger the variance of each $\hat{L}_k$ estimate relative to the other $\hat{L}_k$ variances, the smaller the weight. The resulting estimate of current month employment $\hat{Y}_{iat}$ is defined as:

Equation 8. Employment calculated using SDM

$$\hat{Y}_{iat} = \left(W_{iat,1}\hat{L}_{iat,1} + W_{iat,2}\hat{L}_{iat,2} + W_{iat,3}\hat{L}_{iat,3}\right)\hat{Y}_{iat-1}$$

where:

i = the CES industry.

a = the geographic location for that series. For National, a is the Nation as a whole. For States, a is the State as a whole. For MSAs, a is the metropolitan area.

$\hat{Y}_{iat}$ = current month t employment estimate for domain ia defined by the intersection of industry i and geographic location a.

$\hat{L}_{iat,1}$ = current month relative over-the-month change estimate based on available sample responses for domain ia.

$W_{iat,1}$ = current month weight assigned to $\hat{L}_{iat,1}$ based on the variances $\hat{L}_{iat,1}$, $\hat{L}_{iat,2}$, and $\hat{L}_{iat,3}$. The weights $W_{iat,2}$ and $W_{iat,3}$ are defined similarly.

$\hat{L}_{iat,2}$ = current month relative over-the-month change estimate based on time series forecasts using historical universe employment counts for domain ia. These historical universe employment counts are available from January 1990 to 12 months prior to the current month t.

$\hat{L}_{iat,3}$ = current month relative over-the-month change estimate based on a synthetic estimate of the relative change that uses all sample responses in the State that includes the MSA's geographic location a for industry i. **This variable and its corresponding weight are only used in conjunction with MSA level SDM estimation.**

$\hat{Y}_{ia,t-1}$ = previous month employment estimate for domain ia from the SDM.

It is possible that for a given industry i and geographic location a, one or even two of the inputs $\hat{L}_{iat,k}$ to the model are assigned weights of zero. The reasons for assigning a weight of zero to a model input are due to concerns regarding the stability of the inputs. For example, if $\hat{L}_{iat,1}$ or $\hat{L}_{iat,3}$ has five or fewer responses, then it is assigned a weight of zero. If $\hat{L}_{iat,2}$ exhibits an unstable variance or has extremely poor model fit, then it may also be assigned a weight of zero. In these cases, the small domain model estimate may be based on only one or two of the three described inputs.

The model defined above is employed for both State and area and National, but National does not identify the inputs to the model by State or MSA, only by industry. Consequently, National estimates have only one geographic location *a* that includes all 50 States and the District of Columbia.

Sampling errors are not applicable to the estimates made using the small domain model. The measure available to judge the reliability of these modeled estimates is their performance over past time periods compared with the universe values for those time periods. These measures are useful, however, it is not certain that the past performance of the modeled estimates accurately reflects their current performance.

It should also be noted that extremely small estimates of 2,000 employees or less are potentially subject to large percentage revisions that are caused by occurrences such as the relocation of one or two businesses, or a change in the activities of one or two businesses. These are non-economic

classification changes that relate to the activity or location of businesses and will be present for sample-based estimates as well as the model-based estimates.

The SDM in CES estimation. CES State and area has been using the CES SDM for some State and metropolitan area employment series which have small samples since 2003, while CES National began using the SDM beginning in 2007.

National employment estimates for six industries are produced using the CES SDM. Relatively small sample sizes in these industries limit the reliability of the weighted-link-relative estimator for estimates of all employees (see Table 8).

Table 8. National small domain model industries [1]

CES Industry Title	CES Industry Code
Direct health and medical insurance carriers	55-524114
Lessors of nonfinancial intangible assets	55-533000
Tax preparation services	60-541213
Other technical consulting services	60-541690
Remediation services	60-562910
Recreational and vacation camps	70-721214

[1]Formerly Table 3.

Birth/Death Model

The CES sample alone is not sufficient for estimating the total employment level because each month new firms generate employment that cannot be captured through the sample. There is an unavoidable lag between a firm opening for business and its appearance on the CES sample frame. The sample frame is built from Unemployment Insurance (UI) quarterly tax records. These records cover virtually all U.S. employers and include business births, but they only become available for updating the CES sampling frame 7-9 months after the reference month. After the births appear on the frame, there is also time required for sampling, contacting, and soliciting cooperation from the firm, and verifying the initial data provided. In practice, CES cannot sample and begin to collect data from new firms until they are at least a year old.
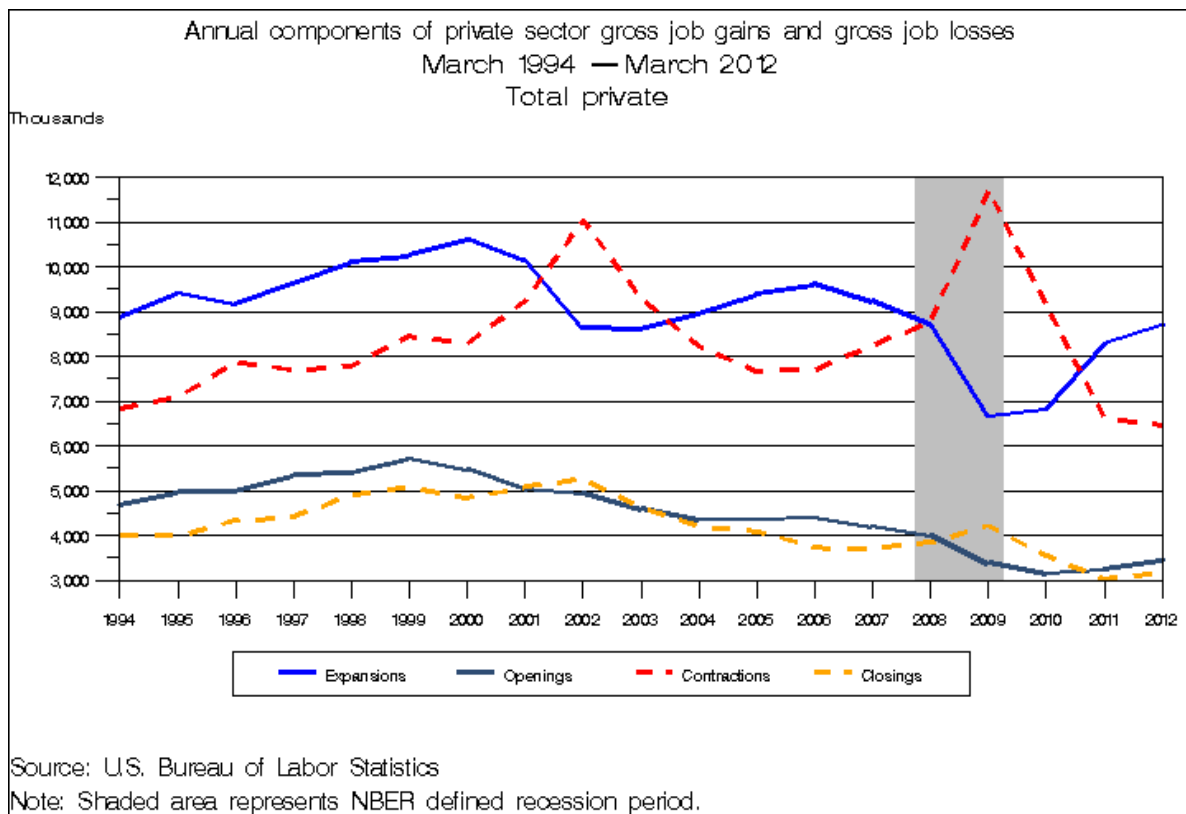
There is a parallel though somewhat different issue in capturing employment loss from business deaths through monthly sample collection. Businesses that have closed are unlikely to respond to the survey, and data collectors may not be able to ascertain until after the monthly collection period that firms have in fact gone out of business. As with business births, hard information on business deaths eventually becomes available from the lagged UI tax records.

Difficulty in capturing information from business birth and death units is not unique to the CES; virtually all current business surveys face these limitations. Unlike many surveys, CES adjusts for these limitations explicitly, using a statistical modeling technique. Other surveys that do not explicitly adjust for business births and deaths are implicitly using the continuing sample units to represent birth and death units. This approach is viable when the primary characteristic of interest is an average measure of some type. However, because the goal of the CES program is to estimate an employment total each month and business births and deaths are important components contributing to these totals, CES uses a model-based adjustment in conjunction with the sample. Without the net birth/death model-based adjustment, the CES nonfarm payroll employment estimates would be considerably less accurate.

CES birth/death modeling technique. Prior to the Current Employment Statistics (CES) program adopting the current birth/death modeling technique, research using historical information indicated that the business birth and death portions of total employment were substantial, but the net contribution of, or the difference between, the two components was relatively small and stable. The research was done using the nearly complete counts of employment developed from the UI tax records that are tabulated under the BLS Quarterly Census of Employment and Wages (QCEW) (www.bls.gov/ore/pdf/st020090.pdf). These QCEW tabulations also form the basis for both the sample frame and annual benchmark for the CES program.

Beyond the research cited above, the Business Employment Dynamics (BED) series published quarterly by BLS, also illustrate how business birth and death employment substantially offset each other. The BED series are also derived from the QCEW. The BED series demonstrate that most of the net employment change each quarter is generated by the expansions and contractions in employment of the continuing businesses and a relatively smaller piece from business openings and closings (which CES refers to as net business births and deaths). As shown in Figure 2 below, continuing businesses which are adding employees (expansions) or subtracting employees (contractions) over the quarter comprise the vast majority of total change; these movements are measured by the CES sample. Employment change contributions from openings (or births) and closings (or deaths) are much smaller and more stable, and the two series offset each other to a large degree. It is these underlying relationships among the components of net employment change that allow the CES to produce accurate estimates using a current monthly sample of continuing businesses and a model-based approach for the residual of net business births and deaths.

Figure 2. Total private not seasonally adjusted BED series (in thousands) [1]

Annual components of private sector gross job gains and gross job losses
March 1994 — March 2012
Total private

Source: U.S. Bureau of Labor Statistics
Note: Shaded area represents NBER defined recession period.

[1]Formerly "Business Employment Dynamics series, seasonally adjusted, 1997-2007 Total Private Employment in thousands".

Birth/death modeling methodology. The CES birth/death methodology has two steps.

Step One - Employment losses from business deaths are excluded from the sample in order to offset the missing employment gains from new business births. Because employment increases from births nearly offset employment decreases from deaths in most months (as illustrated above by the BED data), this step accounts for most of the net of business birth and death employment.

Operationally this is accomplished in the following manner each month. Business deaths that are non-respondents to the survey are automatically excluded because they have no current month data. Death establishments that report zero employment to the survey for the current month are treated the same as non-respondents and also excluded. As a result, the over-the-month change calculation from the sample is based solely on continuing businesses.

For the months subsequent to a business death, the deaths are "kept alive" in the CES estimation process; the growth rate of the continuing units in the sample is applied to them each month. This estimates for the growth of the new business births in the months after their birth but before they can be brought into the sample.

This step accounts for most of the net birth/death employment but not all of it. The residual net employment that is not captured by this step is estimated through an econometric model, described below as Step two.

Step Two - Modeling for the residual of net/birth death employment change. In this step, the CES adjusts its sample-based estimates for the residual net birth/death employment that step one misses. This adjustment is derived from an econometric technique known as ARIMA modeling. ARIMA is a standard econometric modeling technique that is often used to estimate relatively stable series. Outliers, level shifts, and temporary ramps are automatically identified. CES refits the ARIMA models each year, for each basic estimation cell, as part of its annual benchmarking process. Table 9 shows the net birth/death model figures for the post-benchmark period of the benchmark, from April to October of 2012. For more recent months of birth/death information, see www.bls.gov/web/empsit/cesbd.htm.

Table 9. Net Birth/Death Estimates, Post-Benchmark 2012 (in thousands)[1]

CES Industry Title	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Cumulative Total
Mining and logging	1	2	2	2	2	1	2	0	0	12
Construction	28	37	23	3	8	5	1	-16	-22	67
Manufacturing	-4	5	3	-5	4	0	0	0	-1	2
Trade, transportation, and utilities	12	23	7	0	16	13	27	1	5	104
Information	2	5	1	-1	3	-1	4	2	0	15
Financial activities	3	7	2	-2	3	0	14	0	10	37
Professional and business services	61	28	12	17	18	-7	60	-4	0	185
Education and health services	22	15	-11	9	15	16	47	3	0	116
Leisure and hospitality	72	76	79	45	18	-40	-40	-21	6	195
Other services	9	7	4	-2	2	-1	3	-1	1	22
Monthly amount contributed	206	205	122	66	89	-14	118	-36	-1	755

[1]Formerly Table 2-B. Included in the Benchmark Article as Table 3, formerly Text Table A.

The inputs to the ARIMA model are historical observations of the residual net birth/death employment that is not captured by either the sample or the step one imputation described above. These historical observations are derived empirically, from the most recent five years of QCEW historical data. From the QCEW universe employment series, CES classifies each establishment each month as a continuing unit, a birth, or a death. Then sample-based estimates are simulated using the month-to-month change of the continuing units, and using the deaths-to-impute-for-births technique described above in step one. The difference between these simulated estimates

and the actual total employment measured by the QCEW each month, is the residual net birth/death employment. The birth/death residual series assumed the following form:

Equation 9. Birth/death residual

$$\text{Birth/death residual} = \text{Population} - \text{Sample-based estimate} + \text{Error}$$

During the net birth/death modeling process, simulated monthly probability estimates over a 5-year period are created and compared with population employment levels. Moving from a simulated benchmark, the differences between the series across time represent a cumulative birth/death component. Those residuals are converted to month-to-month differences and used as input series to the modeling process.

Because the residual net birth/death employment component is relatively stable, the ratio of it to total employment change can vary substantially from year to year. In slower growth years (for example, March 03-March 04), the ratio is much different than in stronger growth years (for example March 04-March 05). The table also shows than even in a year where total nonfarm employment declines, the residual net birth/death employment component is positive (for example March 01-02). Put another way, the residual net birth death amount itself is relatively stable but its relationship to overall net employment change varies, depending on the magnitude of the overall change, almost by definition.

Quarterly updates to the CES birth/death model. Prior to the release of preliminary January 2011 employment estimates in February 2011, birth/death residuals were calculated on an annual basis and then applied each month during development of monthly estimates. With the release of the January 2011 preliminary estimates, CES began updating the net birth/death model component of the estimation process on a quarterly basis instead of annually. This change allows for the incorporation of QCEW data into the birth/death model as soon as it becomes available and reduces the post-benchmark revision in the CES series. This change does not impact the timing or frequency of CES monthly and annual releases or when benchmarking is done. For more information on the CES switch to quarterly net birth/death forecasting, see www.bls.gov/ces/ces_quarterly_birthdeath.htm.

Effectiveness. On an annual basis CES recalculates nearly two years of establishment survey estimates in a process known as benchmarking. The benchmark process re-anchors the CES estimates to a nearly complete count of employment based on the UI tax records tabulated through the QCEW. During the benchmark process the March CES estimate for a given year is replaced by the employment counts derived from the QCEW.

The benchmark process helps to correct for sampling and modeling error in the CES estimates. It provides a method of both validating and improving the CES employment series. If the birth/death estimator or any other aspect of the CES estimation process has sustained large statistical error over the course of a year, it will be corrected by the benchmarking process. In most years, the benchmark error, measured as the difference between the CES estimate for March and the final QCEW-based March employment level, is relatively small, indicating that the CES estimation process is producing accurate employment estimates. The benchmark error is

generally used as a proxy for total CES estimation error although this interpretation is not entirely accurate, because there is statistical error in the QCEW as well as in the CES. Both data series are subject to non-response, imputation, reporting, and processing errors, which are common to all surveys and administrative records tabulations. However, because the QCEW is not subject to sampling error and provides a reliable source for business birth/death employment, the benchmarking process improves the CES employment series. Beginning with 2003, all industries were estimated using the new sample design and birth/death model. A more detailed description of the benchmarking process can be found later in this document under Benchmarking.

The net birth/death model and benchmark errors. Table 10 below shows that the CES birth/death model adjustment effectively reduces error in CES estimates. The table compares actual benchmark revisions to revisions which would have resulted if CES had not adjusted sample-based estimates with the residual birth/death model, for the March 2003 benchmark year forward. The March 2003 benchmark is the first in which all industries were estimated using the net birth/death model. As an example, for March 2011-2012, if there were no model-based adjustment, a benchmark revision of 915,000 would have occurred for the year; the incorporation of the modeled residual (491,000) reduced the error to 424,000. In most years, the birth/death adjustment reduced the error in the CES estimate of over-the-year change. For more information about the relationship between birth/death error and benchmark errors, see the Issues In Labor Statistics article titled *How the Business Birth/Death Model Improves Payroll Employment Estimates* (www.bls.gov/opub/ils/pdf/opbils70.pdf).

Table 10. Simulated CES benchmark revisions without net birth/death adjustments (in thousands) [1]

Benchmark Year	Birth/death model amount	Actual benchmark revision	Simulated benchmark revision if birth/death adjustments not made
Mar 02-03	470	-122	348
Mar 03-04	642	203	845
Mar 04-05	826	-158	668
Mar 05-06	875	752	1,627
Mar 06-07	1,073	-293	780
Mar 07-08	782	-89	693
Mar 08-09	717	-902	-185
Mar 09-10	336	-378	-42
Mar 10-11	427	162	589
Mar 11-12	491	424	915

[1]Formerly titled "Simulated CES benchmark revisions if net birth/death adjustments not made; Numbers in thousands".

Limitations. The current modeling technique consistently reduces error in the estimate of nonfarm payroll employment, as compared to making no adjustment, however it has limitations. The primary limitation stems from the fact that the model is, of necessity, based on historical data. If there is a substantial departure from historical patterns of employment changes associated with the residual of net business births and deaths, as occurred from 2008 into 2009 during the 2009 benchmark, the model's contribution to error reduction can erode. As with any model that is based on historical data, turning points that do not resemble historical patterns are difficult to incorporate in real time. Because there is no current monthly information available on business births, and because only incomplete sample data is available on business deaths, estimation of this component will always be potentially more problematic than estimation of change from continuing businesses.

The net birth/death model and seasonal adjustment. The birth/death model component is added to the sample-based component to form the not seasonally adjusted employment estimate for each month, as described above. These employment estimates are subsequently seasonally adjusted. Seasonal adjustment smoothes the employment series by removing normal seasonal variations due to factors such as weather and holidays; therefore the seasonally adjusted over the month employment changes are generally much smaller than the unadjusted changes.

Users who wish to compare the model's contribution to overall employment change reported for a month need to compare against the unadjusted estimates, not the seasonally adjusted series. Comparing the model amounts to seasonally adjusted estimates generally results in an overstatement of the model-based component's contribution to over-the-month employment change.

The birth/death model component generally shows the same overall seasonal patterns as the sample-based component. For example, Total nonfarm employment shows a large seasonal increase in employment each April; the model also shows a relatively large net addition to employment each April. Similarly total nonfarm employment records a large drop in employment each January and the model estimates a substantial drop in net birth/death employment each January. An example of the net birth/death model components versus overall net employment change from April 2011 to March 2012 (subsequent to the March 2012 benchmark implementation) is shown below in Table 11. The April 2011 model amount of 172,000 should be viewed as a component of the 1,218,000 not seasonally adjusted employment change, rather than as a component of the 304,000 seasonally adjusted change.

Table 11. Net birth/death and over the month change in Total nonfarm employment (in thousands) [1]

	Apr 2011	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar 2012
Birth/death model amount	172	211	141	5	89	-26	116	-30	-1	-367	91	90
Not seasonally adjusted total employment change	1,218	684	490	-1,272	276	747	921	331	-164	-2,635	947	901
Seasonally adjusted total employment change	304	115	209	78	132	225	166	174	230	311	271	205

[1]Formerly titled "Birth/death model adjustment and over the month change in total nonfarm employment, in thousands, April 2006-March 2007".

Aggregation Procedures

CES estimates at the basic estimating level and then aggregates these estimates to higher industry levels. Aggregation procedures are specific to the data type and published level of precision (i.e. the degree of rounding).

Publication Precision. For employment data types, CES publishes estimates for major industry and aggregate industry sectors in thousands, rounded to the thousands, except for major industry sectors 41-420000 Wholesale trade, 42-000000 Retail trade, 43-000000 Transportation and warehousing, and 44-220000 Utilities, which are published in thousands, rounded to the hundreds. More detailed employment estimates are published in thousands, rounded to the hundreds.

For hours and earnings data types, estimates are published using the same procedures for all levels of detail. Hours data types are published in hours, rounded to the tenths. Earnings data types are published in dollars, rounded to the cent.

Employment (AE, PE, and WE). AE data types use the same method for aggregation. Basic level estimates, rounded to the hundreds, are aggregated to summary level estimates up to and including major industry sectors and are then rounded to the published precision. Aggregate industry sector estimates are then calculated by summing the rounded major industry and aggregate industry sector estimates that make up the aggregate industry sector and then rounded according to the published precision.

Average weekly hours (AE and PE). The aggregation method for average weekly hours (AWH) of AE and PE is identical, with the appropriate substitution of AE values or PE values in the following formulas. AWH are estimated at the basic level and combined with employment estimates for the same basic level to calculate aggregate employee hours. Aggregate Employee Hours (AH) are rounded to the tenths at the basic estimating level and calculated as shown:

Equation 10. Aggregate hours

$$AH = AWH \times Emp$$

where:

AH = current month aggregate employee hours calculation for the basic level, rounded to the tenths

AWH = current month AWH estimate for the basic level, rounded as published

Emp = current month employment estimate for the basic level, rounded as published

Next, aggregate employee hours are added up to the summary levels. Average weekly hours, rounded to the tenths, are calculated for the summary level by:

Equation 11. Summary level average weekly hours

$$AWH = AH \div Emp$$

where:

AWH = current month average weekly hours estimate for the summary level, rounded to the tenths

AH = current month aggregate employee hours calculation for the summary level, rounded to the tenths

Emp = current month employment estimate for the summary level, rounded according to published precision

Average hourly earnings (AE and PE). The aggregation method for average hourly earnings (AHE) of AE and PE is identical, with the appropriate substitution of AE values or PE values in

the following formulas. AHE are estimated at the basic level and combined with employment estimates for the same basic level to calculate aggregate employee hours (AH). Calculation of AH is identical to that described for AWH.

Aggregate payroll (PR) is calculated using basic level AWH, AHE, and employment. Basic level PR calculations are rounded to the cent and are defined as:

Equation 12. Aggregate payroll

$$PR = AHE \times AWH \times Emp$$

where:

PR = current month aggregate payroll calculation for the basic level, rounded to the cent

AHE = current month average hourly earnings estimate for the basic level, rounded as published

AWH = current month average weekly hours estimate for the basic level, rounded as published

Emp = current month employment estimate for the basic level, rounded according to published precision

To calculate the summary level estimates, summarize the aggregate employee hours and aggregate payroll to the summary level. Average hourly earnings, rounded to the cent, are calculated for the summary level by:

Equation 13. Summary level average hourly earnings

$$AHE = PR \div AH$$

where:

AHE = current month average hourly earnings estimate for the summary level, rounded to the cent

AH = current month aggregate employee hours calculation for the summary level, rounded to the tenths

PR = current month aggregate payroll calculation for the summary level, rounded to the cent

Caution in aggregating State data. The National estimation procedures used by CES are designed to produce accurate National data by detailed industry; correspondingly, the State estimation procedures are designed to produce accurate data for each individual State. State estimates are not forced to sum to National totals nor vice versa. Because each State series is

subject to larger sampling and nonsampling errors than the National series, summing them cumulates individual State level errors and can cause distortion at an aggregate level. For more information about State and metropolitan area level CES data, see the State and area employment website at http://www.bls.gov/sae/.

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Seasonal Adjustment

The CES program employs a concurrent seasonal adjustment methodology to seasonally adjust its National estimates of employment, hours, and earnings. Under concurrent methodology, new seasonal factors are calculated each month using all relevant data up to and including the current month period.

Many CES data users are interested in the seasonally adjusted over-the-month changes as a primary measure of overall National economic trends. Therefore, accurate seasonal adjustment is an important component in the usefulness of these monthly data. This following section discusses in detail the seasonal adjustment methodology and software employed by CES. It is important to note that this describes seasonal adjustment only as it relates to the CES program's implementation. There are other aspects of seasonal adjustment that are not discussed here.

Seasonal adjustment and X-12 ARIMA. The CES program uses X-12 ARIMA software developed by the U.S. Census Bureau to seasonally adjust the monthly estimates. The X-12 ARIMA software is available on the U.S. Census Bureau web site at www.census.gov/srd/www/x12a/. The site contains the following information:

- Program files for the latest PC version of X-12 ARIMA
- Program files for the latest UNIX workstation version of X-12 ARIMA
- Program files for X-12 Graph, a companion graphics package
- Installation instructions
- Reference manual

The remainder of this documentation describes how the CES program employs X-12 ARIMA for seasonal adjustment purposes. Specifically, it describes the input files used in the CES program's implementation and commands used to invoke the software. This is not a substitute for formal X-12 ARIMA training. There are other uses and features of X-12 ARIMA that are not discussed in this section. The U.S. Census Bureau offers more intensive training for X-12 ARIMA and seasonal adjustment. Contact the Census Bureau or visit their website at http://www.census.gov/ for more details.

Seasonally adjusting CES data. For published AE series, the CES program seasonally adjusts many series at the 3-, 4-, 5-, and 6-digit NAICS level. However, only the seasonally adjusted 3-digit NAICS level estimates are used to aggregate to the higher levels. The seasonally adjusted series that are published at more detailed levels than the 3-digit NAICS are considered to be independent series and are not included in aggregation of seasonally adjusted series. For example, seasonally adjusted data at the 5-digit NAICS are not aggregated to form seasonally

adjusted 4-digit NAICS series. Instead the 4-digit NAICS and the 5-digit NAICS level series are independently seasonally adjusted.

Most series are seasonally adjusted by directly applying the seasonal adjustment factors to the series with the exception of the component series used in indirect seasonal adjustment. In some cases, 3-digit NAICS series are indirectly seasonally adjusted by aggregating the seasonally adjusted employment level of their component series. For indirectly seasonally adjusted 3-digit NAICS series, the seasonal adjustment factors are applied to the component series rather than to the 3-digit NAICS series. Indirectly seasonally adjusted series are noted in Table 13.

For published PE series and for published hours and earnings series for both PE and AE, the CES program seasonally adjusts at the major industry sector level for all industries except Manufacturing which is seasonally adjusted at the 3-digit NAICS level. The seasonally adjusted PE, seasonally adjusted hours and earnings for PE, and seasonally adjusted hours and earnings for AE are aggregated from the 3-digit level in Manufacturing industries and are aggregated from the major industry sector level for all other industries to get seasonally adjusted aggregate sectors.

For published PE and AE overtime series, the CES program seasonally adjusts Manufacturing series at the 2-digit NAICS level, or the Durable goods and Nondurable goods levels. These seasonally adjusted overtime series are aggregated to the Manufacturing level.

For published WE series, the CES program seasonally adjusts at the major industry sector level for all industries. The seasonally adjusted WE are aggregated from the major industry sector level for all industries.

The CES program's current implementation of seasonal adjustment controls for several calendar effects:

- **4 vs. 5 week adjustment** — This adjusts for inconsistencies in the seasonally adjusted series that arise because of variations of 4 or 5 weeks between reference periods in any given pair of months. In highly seasonal months and industries, this variation can be an important determinant of the magnitude of seasonal hires or layoffs that have occurred at the time the survey is taken, thereby complicating seasonal adjustment.
- **Length of pay adjustment** — This adjusts for distortions in CES hours and earnings series caused by differences in the number of working days in a pay period from month-to-month.
- **Floating holiday adjustment** — This adjusts for significant effects associated with the relative timing of the reference period of the survey and the Easter and Labor Day holidays. These holidays do not occur at exactly the same time every year which complicates the seasonal adjustment process.

More information about the calendar-related fluctuations in CES data is available on the BLS website at www.bls.gov/ces/cesfltxt.htm.

Special notice regarding seasonal adjustment for AE hours and earnings. Concurrent with the release of January 2010 data, the CES program began publishing AE hours and earnings as official BLS series. The AE hours and earnings series are published at the same level of industry detail as PE hours and earnings series and are published on both a not seasonally adjusted and a seasonally adjusted basis.

CES has at least five full years of history for the AE hours and earnings series, which allows for incorporating the special model adjustments for variation due to the calendar effects (4- vs. 5-week, 10- vs. 11-day). Also, generally CES uses 10 years of not seasonally adjusted data as an input to seasonal adjustment. This year, CES will replace the entire 82 months of seasonally adjusted AE hours and earnings data, ensuring all data is adjusted using the same methodology.

CES seasonal adjustment input files. All controllable variables remain fixed during the year. For example, the ARIMA model, outliers, transformation specification, and historical data are held constant, and the same calendar treatments are used throughout the year. Once a year, as part of the annual CES benchmark procedure, all seasonal adjustment specifications are reviewed for each series. Any changes are implemented and kept constant until the next annual benchmark. Also during the annual benchmark, estimates for the five most recent years are re-seasonally adjusted using the new specifications. After 5 years of revisions, seasonally adjusted data are frozen.

The CES program uses the following input files when seasonally adjusting estimates:

- Specification file
- Input data file
- Prior-adjustment file
- User-defined regression variables (dummy variables) file
- Metafile

More details follow on each input.

Specification file. An input specification file, or a "spec" file, is a text file used to specify program operations. The spec file is composed of functional units called specifications (or "specs"). Each spec unit comprising the spec file controls the options for a specific function. There are 15 different specs that can be used in a spec file; however, the CES program's implementation typically employs only 8 specs. These specs are:

- SERIES spec — this specifies the location and format of the data
- TRANSFORM spec — this specifies a data transformation
- REGRESSION spec — this specifies any regression components
- ARIMA spec — this specifies the ARIMA model to be used
- ESTIMATE spec — this estimates the regARIMA model
- FORECAST spec — this generates forecasts of seasonal factors
- OUTLIER spec — this specifies automatic outlier detection
- X11 spec — this generates and controls the seasonal adjustment process
- COMPOSITE spec — this is a special spec used only during indirect seasonal adjustment

Each spec used by the CES program is covered in greater detail at the end of this section in Anatomy of a Spec File.

In the CES program's implementation, each seasonally adjusted employment series has its own spec file ending in a ".spc" file extension. The ".spc" extension is not recognizable by all operating systems and usually needs to be opened with a text editor such as TextPad, Wordpad, or Notepad. Also, it is important to remember that when running X-12 ARIMA in DOS, the name of the spec file must be 8 characters or less. This is a limitation of DOS, not X-12 ARIMA. All of the spec files currently used in production can be downloaded from www.bls.gov/web/empsit/cesseasadj.htm.

Input Data File. The input data file consists of not seasonally adjusted CES estimates for all series that have a corresponding seasonally adjusted series and is referred to in the SERIES spec of the spec file. The CES implementation reads input data from a text file in "free format" style. In the free-format style, data are delimited with either tabs or spaces, and only the input data are included — dates and other descriptive information are excluded. Instead, information describing the data is specified in the SERIES spec using the START and PERIOD arguments. The full path and name of the input data file is specified using the FILE argument (see Figure 3).

Figure 3. Input Data File Specifications[1]

```
SERIES {
    TITLE = "Computer and electronic products"
    START = 1993.01
    PERIOD = 12
    SAVE = A1
    PRINT = BRIEF
    NAME = '31334000 – AE'
    FILE = 'c:\AE31334000.dat'
    }
```

[1]Formerly Figure 1.

CES data can be extracted from the BLS website at www.bls.gov/ces/data.htm. However, in some cases, not seasonally adjusted data extracted from the BLS website will differ from what the CES program actually uses in seasonal adjustment. In particular, data extracted from the BLS website will reflect any strikes or other prior adjustments that have taken place. Before running seasonal adjustment, the CES program will reverse these effects so that they will not be considered when calculating the seasonal factors. Also, the CES program uses unrounded data when running seasonal adjustment — data on the BLS website are rounded.

Prior Adjustment File. As mentioned in the previous section, in some cases the CES program will modify the not seasonally adjusted estimates (input data) before running X-12 ARIMA. This is done to ensure that non-seasonal events such as strikes are not included in the calculation of the seasonal factors. Once the seasonal factors are calculated, they are applied to the original data

— i.e., the not seasonally adjusted data that reflects the non-seasonal event — to calculate the seasonally adjusted estimate. To read more about the impact of strikes on CES data, visit the BLS website at www.bls.gov/ces/cesstrk.htm.

The latest prior adjustment file used in the seasonal adjustment of CES data can be downloaded from www.bls.gov/web/empsit/cesseasadj.htm. In the example shown below in Figure 4, the first column contains the 14-digit CES NAICS tabcode. This tabcode identifies the series by an 8-digit industry code, followed by three zeros used as placeholders, a 2-digit datatype code, and a single digit indicating seasonal adjustment (3 for not seasonally adjusted, 5 for seasonally adjusted). The tabcode structure is similar to the CES series ID structure, described on the CES NAICS webpage (www.bls.gov/ces/cesnaics.htm#2.3). The second column contains the year, and the next 12 columns represent the months of the year in sequential order (January through December). The file contains both positive and negative numbers. The positive numbers reflect a strike and are added to the not seasonally adjusted data before running X-12 ARIMA. The negative numbers reflect the buildup of employment associated with the decennial census and are added to the not seasonally adjusted data before calculating the seasonal factors.

Figure 4. Prior adjustment file format [1]

	A	B	C	D	E	F	G	H	I	J	K	L	
1	naicstab14	year	janpadj	febpadj	marpadj	aprpadj	maypadj	junpadj	julpadj	augpadj	seppadj	octpadj	no
497	31331000000013	1997	3700	3700	3700	3700	3700	3700	3700	.		1100	
498	31331000000013	1998	.	.	.	.	1300	1300	8800	.		2000	
499	31331000000013	1999	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	
500	31331000000013	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	.	
501	31331000000013	2001	1700	.	.	.	.	.	.	.	.	.	
502	31331000000033	1990	.	.	.	.	.	.	.	.	.	.	
503	31331000000033	1991	1600	1600	1600	1600	1600	1600	1600	1600	1600	3000	
504	31331000000033	1992	1600	1600	1600	1600	1600	1600	.	.	.	.	
505	31331000000033	1994	.	.	.	3200	3200	.	600	600	.	.	
506	31331000000033	1995	.	.	.	.	.	.	.	.	1700	1700	.
507	31331000000033	1996	.	.	.	.	.	.	.	.		3700	

[1]Formerly Figure 2.

User-Defined Regression Variable File. As mentioned earlier, the CES program's current implementation of seasonal adjustment controls for several non-economic calendar related fluctuations in the estimates. This is done with the inclusion of user-defined regression (or "dummy") variables. The dummy variables are defined in the REGRESSION spec of the spec file. The dummy files vary depending upon the type of calendar event being treated. Table 12 lists the dummy files used and the calendar event(s) they are used to treat.

Table 12. Dummy Files with Calendar Treatment [1]

Dummy File	Calendar Event Treated
Fdum8606.dat	4 vs. 5 week effect
Fdumpc96.dat	4 vs. 5 week effect plus a special adjustment for the presence/absence of poll workers in local government
Fdumpcw6.dat	4 vs. 5 week effect plus a special adjustment for the presence/absence of poll workers in local government (used with women employee series only)
Fdumel96.dat	4 vs. 5 week effect plus Easter/Labor Day adjustment
Dumlp06.dat	10/11 day effect
Dumlpel6.dat	10/11 day effect plus Easter/Labor Day adjustment

[1]Formerly Table 1.

The dummy values are usually 1 and 0, with weights assigned so that the effect over a 10 year period sums to zero. The latest user-defined regression files used in the seasonal adjustment of CES data can be downloaded from www.bls.gov/web/empsit/cesseasadj.htm.

Metafile. The metafile is a text file ending in a ".mta" file extension and is used when running X-12 ARIMA on more than one series. It is essentially a list of the complete path and filename — without the extension — of all of the input spec files. Only one spec file is listed per row. As with the individual spec files, it is important to remember that when running X-12 ARIMA in DOS, the name of the metafile must be 8 characters or less.

Running X-12 on a single series. Use the following command at the DOS prompt when running X-12 ARIMA on a single series:

{path1\}x12a {path2\}spec file name -options

where {path1\} = path of the X-12 ARIMA program
x12a = command informing X-12 program to execute
{path2\} = path of the spec file
spec file name = name of the input spec file you want to adjust (without the extension)
options = see X-12 manual for list of options

Example: At the DOS prompt, type:

c:\x12s\x12a c:\x12\seasadj\AE113310 -w

(where AE113310.spc is the series you want to adjust)

Running X-12 on multiple series. Use the following command at the DOS prompt when running X-12 ARIMA on more than one series:

{path1\}x12a -m {path2\}metafile name -options

where {path1\} = path of the X-12 ARIMA program
x12a = command informing X-12 program to execute
-m = flag that informs X-12 that the subsequent named file is a metafile
{path2\} = path of the metafile
metafile name = name of the metafile (without the extension) containing the input spec files
options = see x-12 manual for list of options

Example: At the DOS prompt, type:

c:\x12s\x12a -m c:\x12\seasadj\pubAE -w

(where pubAE.mta is the metafile you are using)

Output from X-12 ARIMA. When X-12 ARIMA is run, several output files are generated by default. The output files are saved in the same location as the input specification files.

- Main output file (*.out)
- Error output file (*.err)
- Log output file (*.log)

More details follow on each of the output files.

Main Output File (*.out). The X-12 ARIMA output is written to a text file ending in a ".out" extension. Output from the CES implementation contains many different tables and statistics, including:

- Table displaying the original, not seasonally adjusted series
- Table displaying the final seasonally adjusted series
- Table displaying the final seasonal factors
- Statistics related to model selection
- Statistics related to outlier detection
- A summary of seasonal adjustment diagnostics
- Quality control statistics

Individual specs in the spec file control their contribution to this output using optional PRINT arguments (see Figure 5). For example, within the X11 spec, BRIEF specifies that only certain tables or plots are printed, while the minus sign in front of a name (such as -SPECSA or -SPECIRR) means that particular table or plot should be suppressed from the output. In this example, without the options -SPECSA and -SPECIRR, both of the plots would be printed by default under the BRIEF option.

Figure 5. The PRINT argument in the X11 spec[1]

```
X11 {
    MODE = MULT
    PRINT = (BRIEF –SPECSA –SPECIRR)
    SAVE = (D10 D11 D16)
    APPENDFCST = YES
    FINAL = USER
    SAVELOG = (Q Q2 M7 FB1 FD8 MSF)
    }
```

[1]Formerly Figure 3.

It is important to remember that every time X-12 ARIMA is run on a particular series, the *.out file is overwritten, unless an alternate name or directory is specified.

Error Output File (*.err). Input errors are written to a text file ending in an ".err" extension. If the error is fatal, **ERROR:** will be displayed before the error message. If the error is not fatal, **WARNING:** will be printed before the message. Non-fatal errors (or warnings) will not stop the program, but should be an alert to use caution and to check input and output carefully.

It is important to remember that, as is the case with all output files, every time X-12 ARIMA is run on a particular series, the *.err file is overwritten, unless an alternate name or directory is specified.

Log Output File (*.log). A summary of modeling and seasonal adjustment diagnostics are written to a text file ending in a ".log" extension. Individual specs in the specification file control their contribution to this output using optional SAVELOG arguments. When X-12 ARIMA is run on an individual spec file, the log file is stored with the same name and directory as the spec file. However, when X-12 is run using a metafile, the log file is stored with the same name and directory as the metafile. As is with all output files, every time X-12 ARIMA is run, the *.log file is overwritten unless an alternate name or directory is specified.

Other Output Files. Other output files are generated as specified in the spec file using the SAVE argument. In the CES program's implementation, the following additional output files are generated:

- ***.a1** – This file contains the not seasonally adjusted data with associated dates and is specified in the SERIES spec
- ***.ao** – This file contains outlier factors with associated dates and is specified in the REGRESSION spec
- ***.d10** – This file contains final seasonal factors with associated dates and is specified in the X11 spec
- ***.d11** – This file contains final seasonally adjusted data with associated dates and is specified in the X11 spec

- ***.d16** – This file contains combined seasonal and trading day factors with associated dates and is specified in the X11 spec
- ***.td** – This file contains final trading day factors with associated dates and is specified in the REGRESSION spec

Indirect Seasonal Adjustment. The CES program generally seasonally adjusts published series directly at the 3-digit NAICS level and aggregates to the higher levels. However, there are some exceptions to this rule. In a few of the AE series, the CES program will seasonally adjust at a level lower than the 3-digit NAICS level. In these instances, the CES program seasonally adjusts the 3-digit series indirectly; i.e., all of the component (lower level) series are seasonally adjusted directly and aggregated up to the composite (3-digit) level. Indirect seasonal adjustment is performed on these series because some of the individual component series that aggregate to the composite series exhibit different seasonal patterns that may be masked if seasonally adjusted directly at the aggregate level.

The spec file for the composite series differs somewhat from normal CES implementation. The most significant difference is at the beginning of the spec file, where the SERIES spec is replaced with the COMPOSITE spec. Running X-12 employing the COMPOSITE spec produces an indirect seasonal adjustment of the composite series as well as a direct adjustment. Output from the indirect adjustment is saved under non-standard file extensions.

- Aggregated not seasonally adjusted data with associated dates are saved in a text file with the extension *.cms (instead of *.a1 under direct seasonal adjustment)
- Final indirect (aggregated) seasonally adjusted data with associated dates are saved in a text file with the extension *.isa (instead of *.d11 under direct seasonal adjustment)
- Final seasonal factors for aggregated series with associated dates are saved in a text file with the extension *.isf (instead of *.d16 under direct seasonal adjustment)

The COMPOSITE spec is covered in greater detail at the end of this section in Anatomy of a Spec File. Spec files for the component series are constructed the same way as a standard X-12 ARIMA run (because they are only adjusted directly, as is standard practice).

A current list of industries that are indirectly seasonally adjusted follows in Table 13, along with their component series. For any given series, not all of the component series are published at first closing. Some series are published during a later release. In the table below, component series published with the first preliminary data release are denoted with an asterisk (*).

Table 13. Indirectly seasonally adjusted CES series [1]

Composite Series	Component Series
10-212000	10-212100*, 10-212200, 10-212300
20-236100	20-236115, 20-236116, 20-236117, 20-236118
20-236200	20-236210, 20-236220

Composite Series	Component Series
20-238000	20-238110, 20-238120, 20-238130, 20-238140, 20-238150, 20-238160, 20-238170, 20-238190, 20-238210, 20-238220, 20-238290, 20-238310, 20-238320, 20-238330, 20-238340, 20-238350, 20-238390, 20-238910, 20-238990
31-334000	31-334100*, 31-334200*, 31-334300, 31-334400*, 31-334500*, 31-334600
42-441000	42-441100*, 42-441200, 42-441300
42-452000	42-452100*, 42-452900
55-522000	55-522100*, 55-522200, 55-522300
60-540000	60-541100*, 60-541200*, 60-541300*, 60-541400, 60-541500*, 60-541600*, 60-541700, 60-541800, 60-541900
60-561000	60-561100, 60-561200, 60-561300*, 60-561400*, 60-561500, 60-561600, 60-561700*, 60-561900
65-621000	65-621100*, 65-621200, 65-621300, 65-621400*, 65-621500, 65-621600*, 65-621900
65-623000	65-623100*, 65-623200, 65-623300, 65-623900
65-624000	65-624100, 65-624200, 65-624300, 65-624400*

[1]Formerly Table 2. CES Series Indirectly Seasonally Adjusted.

Anatomy of a spec file. For published series, the CES program generally seasonally adjusts at the 3-digit NAICS level and aggregates to the higher levels. A small number of series are independently seasonally adjusted at a higher level of detail, but these are not included in the aggregation of seasonally adjusted data. One of the main inputs to the seasonal adjustment process is a unique file called a spec file (see Figure 6). The spec file contains a set of specs that give X-12 ARIMA various information about the data and the desired seasonal adjustment options and output. Each specification inside the spec file controls options for a specific function. For example, the SERIES spec contains specifications on the location and format of the data, while the X11 spec sets seasonal adjustment options such as seasonal adjustment transformation mode, output files to save, and diagnostic statistics to print.

Figure 6. CES seasonal adjustment spec file[1]

[1]Formerly "Example of a specification file".

The spec file is free format, and blank spaces, tabs, and blank lines may be used as desired to make the spec file more readable. The order of the specification statements in the spec file (with one exception), and the order of the arguments within the braces of any spec do not matter. The only requirement is that the SERIES spec or COMPOSITE spec must be the first spec.

More detail on each spec used by CES follows.

1. SERIES spec

SERIES{

TITLE = "Logging"

START = 1993.01

PERIOD = 12

SAVE = A1

PRINT = BRIEF

NAME = '10113310 – AE'

FILE = 'c:\AE10113310.dat'}

The main function of the SERIES spec is to specify details about the input data series such as the name, format, and location of the data. The CES implementation employs seven options or arguments with the SERIES spec.

- TITLE — A descriptive title for the series. In this example, the title is **"Logging"**.
- START — The start date of the time series being adjusted. In this example, the start date is **January, 1993**.
- PERIOD — Seasonal period of the series. In this example, the period is 12 (which means monthly).
- SAVE — Specifies output to be saved. In this example, the time series data with associated dates will be saved in an output file called AE10113310.**A1**.
- PRINT — Specifies output to be printed. In this example, **BRIEF** specifies that only certain tables are printed.
- NAME — The name of the time series. In this example, the name is **"10113310 – AE"**.
- FILE — The complete path and name of the file containing the time series data. In this example, the complete path and filename is **"c:\AE10113310.dat"**.

2. TRANSFORM spec

TRANSFORM{FUNCTION = LOG}

The main function of the TRANSFORM spec is to transform or adjust the time series prior to estimating a regARIMA model. The CES implementation employs one argument with the TRANSFORM spec.

- FUNCTION — Specifies the method to transform the time series. In this example, the transformation method is log transformation, which means X-12 will compute a multiplicative seasonal decomposition.

3. REGRESSION spec

REGRESSION{

VARIABLES = (AO1995.02 AO1996.01 AO1999.01)

USER = (dum1 dum2 dum3 dum4 dum5 dum6 dum7 dum8 dum9 dum10 dum11)

START = 1986.01

FILE = 'c:\FDUM8606.dat'

USERTYPE = TD

SAVE = (TD AO) }

The main function of the REGRESSION spec is to specify the regression components of a regARIMA model. The CES implementation employs up to six options with the REGRESSION spec.

- VARIABLES — Specifies any predefined regression variables to be included in the model. In the CES implementation, predetermined outliers are listed after the VARIABLES argument. In this example, predetermined outliers include **AO1995.02** (February 1995), **AO1996.01** (January 1996), and **AO1999.01** (January 1999).
- USER — Specifies the names for any user-defined regression variables. CES defines regression variables to adjust for significant effects associated with calendar related events such as (1) the relative timing of the reference period of the survey and the Easter and Labor Day holidays; (2) variations of 4 or 5 weeks between reference periods in any given pair of months, and; (3) differences in the number of working days in a pay period from month-to-month. In this example, the regression variables are named **dum1, dum2, dum3, dum4, dum5, dum6, dum7, dum8, dum9, dum10, and dum11**.
- START — Specifies the start date for the data values for the user-defined regression variables. In this example, the start date is **January, 1986**.
- FILE — The complete name of the file containing the data values for the user-defined regression variables, including the path. In this example, the filename, including the path, is **"c:\FDUM8606.dat"**.
- USERTYPE — Specifies a type of model-estimated regression effect to each user-defined regression variable. In this example, the type of model-estimated regression effect is defined as **TD**, or trading day.
- SAVE — Specifies output to be saved. In this example, trading day factors with associated dates will be saved in an output file called AE10113310.TD, and outlier factors with associated dates will be saved in an output file called AE10113310**.AO**.

Note: Not every option is used in every spec file. For example, if no predetermined outliers exist, then the VARIABLES argument will not be used. Likewise, if we are not treating a particular series for calendar effects, then the USER, START, FILE, and USERTYPE arguments will not be used.

4. ARIMA spec

ARIMA{MODEL = (2 1 0) (0 1 1)}

The main function of the ARIMA spec is to specify the ARIMA part of a regARIMA model. The CES implementation employs 1 option with the ARIMA spec.

- MODEL — Specifies the actual ARIMA model to be used. In this example, the model is **(2 1 0) (0 1 1)**.

5. ESTIMATE spec

ESTIMATE{MAXITER = 1000}

The main function of the ESTIMATE spec is to estimate the regARIMA model specified by the REGRESSION and ARIMA specs. The CES implementation employs 1 argument with the ESTIMATE spec.

- MAXITER — Specifies the maximum number allowed of autoregressive moving average (ARMA) nonlinear iterations. ARMA is a time-series model that includes both autoregressive (AR) and moving average (MA) nonlinear components. In this example, the maximum number allowed of ARMA iterations is **1000**.

6. FORECAST spec

FORECAST{MAXLEAD = 24}

The main function of the FORECAST spec is to generate forecasts (and/or backcasts) for the time series model given in the SERIES spec using the estimated regARIMA model. The CES implementation employs 1 argument with the FORECAST spec.

- MAXLEAD — Specifies the number of forecasts produced. In this example, the number of forecasts specified is **24 months**.

7. OUTLIER spec

OUTLIER{

CRITICAL = 3.5

TYPES = AO }

The main function of the OUTLIER spec is to perform automatic detection of point outliers, temporary change outliers, level shifts, or any combination of the three. The CES implementation uses this spec to automatically detect point outliers only. CES employs 2 arguments with the OUTLIER spec.

- CRITICAL — Specifies the value to which the absolute values of the outlier t-statistics are compared to detect outliers. In this example, the critical value is **3.5**.

- TYPES — Specifies the types of outliers to detect. The CES implementation uses the OUTLIER spec to automatically detect point outliers only. In this example, the outlier type is **AO** (which signifies point outliers).

8. X11 spec

X11{

MODE = MULT

PRINT = (BRIEF -SPECSA -SPECIRR)

SAVE = (D10 D11 D16)

APPENDFCST = YES

FINAL = USER

SAVELOG = (Q Q2 M7 FB1 FD8 MSF) }

The function of the X11 spec is to control certain aspects of the seasonal adjustment process. For example, the CES implementation uses the X11 spec to control the type of seasonal adjustment decomposition calculated (mode). CES employs 6 arguments with the X11 spec.

- MODE — Specifies the mode of the seasonal adjustment decomposition to be performed. There are four choices: multiplicative, additive, pseudo-additive, and log-additive. In the CES implementation, only the multiplicative or additive modes are employed. In this example, the mode specified is multiplicative (**MULT**).
- PRINT — Specifies output to be printed. In this example, BRIEF specifies that only certain tables or plots are printed. The minus sign in front of a name means that particular table or plot should be suppressed. In this example, **-SPECSA** specifies that a spectral plot of differenced, seasonally adjusted series be suppressed, while **-SPECIRR** specifies that a spectral plot of outlier-modified irregular series be suppressed. Without these options, both plots would be printed under the BRIEF option by default.
- SAVE — Specifies output to be saved. In this example, final seasonal factors with associated dates will be saved in an output file called **AE10113310.D10**; the final seasonally adjusted series with associated dates will be saved in an output file called **AE10113310.D11**; and combined seasonal and trading day factors with associated dates will be saved in an output file called **AE10113310.D16**.
- APPENDFCST — Determines if forecasts of seasonal factors will be included in the X-12 output files and tables that were selected in the SAVE option. If APPENDFCST = yes, then forecasted seasonal factors will be stored. In this example, the APPENDFCST value is **YES**.
- FINAL — Specifies the types of prior adjustment factors (obtained from the REGRESSION and OUTLIER specs) that are to be applied to the final seasonally adjusted series. In this example, FINAL = **USER**, which means that factors derived from

user-defined regressors (or in this example, the dummy variables) are to be applied to the final seasonally adjusted series, removing significant effects associated with calendar related events.

- SAVELOG — Specifies the diagnostic statistics to be printed to the log file. In this example, the following diagnostics will be printed:
  o **Q**, which is the overall index of the acceptability of the seasonal adjustment. The adjustment may be poor if Q > 1.
  o **Q2**, which is the Q statistic computed without the M2 Quality Control Statistic. The M2 values can sometimes be misleading if the trend shows several changes of direction.
  o **M7**, which measures the moving seasonality relative to the stable seasonality found in the series. Any M > 1 indicates a source of potential problems for the adjustment procedure.
  o **FB1**, which is an F-test for stable seasonality, performed on the original series.
  o **FB8**, which is an F-test for stable seasonality, performed on the final ratio of the seasonal-to-irregular components.
  o **MSF**, which is an F-test for moving seasonality.

As previously mentioned, the CES program generally seasonally adjusts published series at the 3-digit NAICS level and aggregates to the higher levels. However, there are a few cases in which CES seasonally adjusts published series at a level lower than the 3-digit NAICS level. In these instances, CES seasonally adjusts the 3-digit NAICS level indirectly; i.e., all of the component or lower level series are seasonally adjusted directly and then aggregated up to the 3-digit level. When this happens, the SERIES spec is replaced by the COMPOSITE spec in the specification file of the 3-digit series.

9. COMPOSITE spec

COMPOSITE{

TITLE = "Construction of buildings"

SAVE = (ISF ISA CMS)

PRINT = BRIEF

NAME = '20236000 - AE'

SAVELOG = (INDTEST INDQ) }

The COMPOSITE spec is used as part of the procedure for obtaining both indirect and direct adjustments of a composite series data series. This spec is required for obtaining composite adjustments and is used in place of the SERIES spec. The COMPOSITE spec can also specify details about the input data series such as the name of the series and which tables are to be printed or stored. The CES implementation employs five options or arguments with the COMPOSITE spec.

- TITLE — A descriptive title for the series. In this example, the title is **"Construction of buildings"**.
- SAVE — Specifies output to be saved. In this example, the aggregated time series data with associated dates will be saved in an output file called AE20236000**.CMS**, the final seasonal factors for the indirect adjustment with associated dates will be saved in an output file called AE20236000**.ISF**, and the final indirect seasonally adjusted series with associated dates will be saved in an output file called AE20236000**.ISA**.
- PRINT — Specifies output to be printed. In this example, **BRIEF** specifies that only certain tables are printed.
- NAME — The name of the time series. In this example, the name is **"20236000 – AE"**.
- SAVELOG — Specifies the diagnostic statistics to be printed to the log file. In this example, the following diagnostics will be printed:
  - **IND TEST**, which is a test for adequacy of composite adjustment.
  - **IND Q**, which is an overall index of the acceptability of the indirect seasonal adjustment.

Revisions

Sample-based Revisions

Effect of Sample Receipts. CES data users typically are most concerned with revisions to over-the-month changes. This section profiles these monthly revisions of CES seasonally adjusted over-the-month changes and the sample collection rates that underlie the revisions.

CES begins collecting sample reports for a reference month as soon as the reference period, the establishment's pay period that includes the 12th of the month, is complete. Collection time available for first preliminary estimates ranges from 9 to 15 days, depending on the scheduled date for the Employment Situation news release. The Employment Situation is scheduled for the third Friday following the week including the 12th of the prior month, with an exception for January. (For January, the news release is delayed a week if the third Friday following the week of the 12th occurs on January 1, 2, or 3.)

Given this short collection cycle for the first preliminary estimates, many establishments are not able to provide their payroll information in time to be included in these estimates. Therefore, CES sample responses for the reference month continue to be collected for two more months and are incorporated into the second preliminary and final sample-based estimates published in subsequent months. (Second preliminary estimates for a reference month are published the month following the initial release, and final sample-based estimates are published two months after the initial release.) *Additional sample receipts are the primary source of the monthly CES employment revisions.*

Sample-based estimates remain final until employment levels are reset to universe employment counts, or benchmarks, for March of each year; the benchmarks are primarily derived from Unemployment Insurance (UI) tax records. The annual benchmarking process results in revised data back to the last annual benchmark for not seasonally adjusted series and back five years for seasonally adjusted series.

Monthly Revisions. Revisions to CES over-the-month changes are calculated by comparing each month's second preliminary over-the-month change to the first preliminary over-the-month change, the final sample-based over-the month change with the second preliminary over-the-month change, and the final sample-based over-the-month change to the first preliminary over-the-month change.

See www.bls.gov/web/empsit/cesnaicsrev.htm for a table of revisions to seasonally adjusted Total nonfarm over-the-month changes from January 1979 forward. The monthly employment change figures shown in the table do not reflect subsequent changes due to the introduction of benchmark revisions, seasonal adjustment, or other updates. Mean revisions and mean absolute revisions for each calendar year are included in the table. Mean absolute revisions indicate the overall magnitude of change to the estimates, while the mean revisions are a measure of whether there is a bias in direction of the revisions. The closer the mean revision is to zero, the less indication that revisions are predominantly either upward or downward. For example, if in a

given year there were 6 upward revisions of 50,000 and 6 downward revisions of 50,000, the mean revision would be 0; however, the mean absolute revision would be 50,000.

Collection Rates. Collection rates are defined as the percent of reports received for a monthly estimate compared to the total number of actively-reporting sample units on the sample registry.

CES collection rates back to 1981 can be found on www.bls.gov/web/empsit/cesregrec.htm.

Much of the month-to-month variation in the first preliminary collection rates is a function of the number of collection days in the individual months. The overall upward trend over time is attributable to replacing decentralized mail collection with automated techniques.

For more information about the methods used to calculate CES estimates of employment, hours, and earnings at all closings, see the section on Monthly Estimation in this documentation.

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Benchmarks

For the establishment, or CES, survey, annual benchmarks are constructed in order to realign the sample-based employment totals for March of each year with the Unemployment Insurance (UI) based population counts for March. These population counts are much less timely than sample-based estimates and are used to provide an annual point-in-time census for employment. For National series, only the March sample-based estimates are replaced with UI counts. For State and metropolitan area series, all available months of UI data are used to replace sample-based estimates. State and area series are based on smaller samples and are therefore more vulnerable to both sampling and non-sampling errors than National estimates.

Population counts are derived from the administrative file of employees covered by UI. All employers covered by UI laws are required to report employment and wage information to the appropriate Labor Market Information Agency (LMI) four times a year. Approximately 97 percent of Private and Total nonfarm employment within the scope of the establishment survey is covered by UI. A benchmark for the remaining three percent is constructed from alternate sources, primarily records from the Railroad Retirement Board (RRB) and County Business Patterns (CBP). This three percent is collectively referred to as noncovered employment and is explained further in the *Calculating noncovered employment* section of this document. The full benchmark developed for March replaces the March sample-based estimate for each basic cell. The monthly sample-based estimates for the year preceding and the year following the benchmark are also then subject to revision. Each annual benchmark revision affects 21 months of data for not seasonally adjusted series and 5 years of data for seasonally adjusted series.

Monthly estimates for the year preceding the March benchmark are readjusted using a "wedge back"; procedure. The difference between the final benchmark level and the previously published March sample estimate is calculated and spread back across the previous 11 months. The wedge is linear; eleven-twelfths of the March difference is added to the February estimate, ten-twelfths to the January estimate, and so on, back to the previous April estimate, which receives one-

twelfth of the March difference. This assumes that the total estimation error since the last benchmark accumulated at a steady rate throughout the current benchmark year.

Estimates for the seven months following the March benchmark (April through October) also are recalculated each year. These post-benchmark estimates reflect the application of sample-based monthly changes to new benchmark levels for March and the re-computation of business birth/death factors for each month.

Following the revision of basic employment estimates, all other derivative series also are recalculated. New seasonal adjustment factors are calculated and all data series for the previous five years are re-seasonally adjusted before full publication of all revised data in February of each year.

Estimates for the November and December following the March benchmark revise due to both impacts of benchmarking and additional sample. Additionally, new sample units are rotated into the survey starting with November.

As an example of benchmark effects, the March 2012 benchmark revisions (published in February 2013) resulted in revised series from April 2011 through December 2012 on a not seasonally-adjusted-basis and revised series from January 2008 through December 2012 on a seasonally-adjusted-basis.

Annual CES benchmark revisions are published along with January first preliminary estimates in February of each year. For example, the annual CES benchmark revisions for March 2012 were published along with the January 2013 first preliminary estimates on February 1, 2013.

The benchmark revision is the difference between the universe count of employment for March and its corresponding sample-based estimate. A table of benchmark revisions from 1979 forward is included in Table 14 below. See www.bls.gov/web/empsit/cesbmart.htm for more details on the benchmarking process.

Table 14.CES Total nonfarm benchmark revisions [1]

Year	Percent difference	Difference in thousands
1979	0.5	447
1980	-.1	-63
1981	-.4	-349
1982	-.1	-113
1983	[2]	36
1984	.4	353
1985	[2]	-3
1986	-.5	-467
1987	[2]	-35
1988	-.3	-326
1989	[2]	47
1990	-.2	-229

Year	Percent difference	Difference in thousands
1991	-.6	-640
1992	-.1	-59
1993	.2	263
1994	.7	747
1995	.5	542
1996	(2)	57
1997	.4	431
1998	(2)	44
1999	.2	258
2000	.4	468
2001	-.1	-123
2002	-.2	-313
2003	-.1	-122
2004	.2	203
2005	-.1	-158
2006	.6	752
2007	-.2	-293
2008	-.1	-89
2009	-.7	-902
2010	-.3	-378
2011	.1	162
2012	.3	424

[1]Formerly "CES Total nonfarm benchmark revisions 1979-2011".

[2] Less than 0.05 percent.

Calculating noncovered employment. Noncovered employment results from a difference in scope between the CES program and the Quarterly Census of Employment and Wages (QCEW) program. The QCEW employment counts are derived from UI tax reports that individual firms file with their State Employment Security Agency (SESA). Most firms are required to pay UI tax for their employees; however, there are some types of employees that are exempt from UI tax law, but are still within scope for the CES estimates. Examples of the types of employees that are exempt are students paid by their school as part of a work study program; interns of hospitals paid by the hospital for which they work; employees paid by State and local government and elected officials; independent or contract insurance agents; employees of non-profits and religious organizations (this is the largest group of employees not covered); and railroad employees covered under a different system of UI administered by the Railroad Retirement Board (RRB). This employment needs to be accounted for in order to set the benchmark level for CES employment.

No single source of noncovered data exists; therefore, CES uses a number of sources to generate the employment counts, including County Business Patterns (CBP) and the Annual Survey of

Public Employment and Payroll (ASPEP) both from the US Census Bureau, the RRB, and the Labor Market Information Agencies (LMIs).

The majority of noncovered employment is calculated using CBP data. Industries for which noncovered employment is derived from the CBP are provided in Table 15. The CBP — which draws from Social Security filings and other records which do include those employees not covered by UI tax laws — is lagged in its publication by approximately two years (e.g. in 2012 the 2010 CBP data was published). To adjust for this lag, CES assumes that the noncovered portion of employment grows or declines at the same rate as the covered portion and trends the CPB data forward using the QCEW trend. The current QCEW employment level is subtracted from the trended CBP figure, and the residual is the noncovered employment level.

Noncovered employment for all CBP based industries, with the exception of Religious organizations, is calculated as follows:

Equation 14. Noncovered employment for CBP-based industries, except Religious organizations

$$N_t = \left(C_{t-2} * \left(\frac{E_t}{E_{t-2}} \right) \right) - E_t$$

where:

N = Noncovered employment estimate
C = CBP employment data for North American Industry Classification System (NAICS) code
E = QCEW employment for NAICS code
t = Benchmark year

Noncovered employment for Religious organizations is calculated by:
Equation 15. Noncovered employment for Religious organizations

$$N_t = \left(C_{t-2} * 0.5 * \left(\frac{E_t + E_{t-2}}{E_{t-2}} \right) \right) - E_t$$

where:

N = Noncovered employment estimate
C = CBP employment data for NAICS 813110
E = QCEW employment for NAICS 813110

t = Benchmark year

Table 15. Noncovered industries calculated using CBP data [1]

NAICS Code	NAICS Industry Title
524113	Direct life insurance carriers
524114	Direct health and medical insurance carriers
524126	Direct property and casualty insurance carriers
524127	Direct title insurance carriers
524128	Other direct insurance carriers, except life, health, & medical
524130	Reinsurance carriers
524210	Insurance agencies and brokerages
611110	Elementary and secondary schools
611210	Junior colleges
611310	Colleges and universities
611410	Business and secretarial schools
611420	Computer training
611430	Management training
611511	Cosmetology and barber schools
611512	Flight training
611513	Apprenticeship training
611519	Other technical and trade schools
611610	Fine arts schools
622110	General medical and surgical hospitals[2]
622210	Psychiatric and substance abuse hospitals[2]
622310	Other hospitals[2]
624310	Vocational rehabilitation services
624410	Child day care services
813110	Religious organizations
813211	Grantmaking foundations
813312	Environment and conservation organizations
813410	Civic and social organizations
813910	Business associations
813940	Political organizations
813990	Other similar organizations

[1]Formerly Table A.

[2]Indicates that noncovered employment is calculated for firms owned both privately and by State and local government.

The estimated employment for industries listed in Table 16 is calculated from the ASPEP data using the following calculation.

Equation 16. Noncovered employment for ASPEP-based industries

$$N_t = \left(N_{t-1} + \left(N_{t-1} * \left(\frac{E_{t-2} - E_{t-3}}{E_{t-3}} \right) \right) \right)$$

where:

N = Noncovered employment estimate
E = Public employment data for higher education*
t = Benchmark year

*Public employment data for higher education is the sum of institutional full time and part time employment, and non-institutional full time and part time employment.

Table 16. Noncovered industries calculated using ASPEP data [1]

NAICS Code	NAICS Industry Title
611210	Junior colleges[2]
611310	Colleges and universities[2]

[1]Formerly Table B.

[2]Indicates that noncovered employment is calculated only for firms owned by State and local government.

Railroad employment estimates are developed based on data provided by the RRB. The RRB data is broken out by railroad class rather than industry so CES prorates the class data out to NAICS code (see Table 17). These data are lagged by one year and are trended forward using a ratio based on the benchmark year and the previous year for the CES series Rail transportation (NAICS 482). This ratio is applied to the RRB data and then mapped to the corresponding NAICS codes.

Table 17. Noncovered industries calculated using RRB data [1]

Rail Class	NAICS Code	NAICS Industry Title
Class 1	482111	Line-haul railroads
Class 2	482112	Short line railroads
Class 3	482112	Short line railroads
Class 8	488210	Support activities for rail transportation
	532411	Commercial air, rail, and water transportation equipment rental and leasing
Class 9	485111	Mixed mode transit systems

Rail Class	NAICS Code	NAICS Industry Title
	485113	Bus and other motor vehicle transit systems
	485999	All other transit and ground passenger transportation

[1]Formerly Table C.

Over time some sources from which CES draws input data have become unreliable. Where possible CES has tried to find new sources of input data, but for series that no longer have reliable input data, CES trends forward the previous year's noncovered employment levels using a ratio derived from QCEW employment data. These industries are contained in Table 18 and are calculated using the following method.

Equation 17. Noncovered employment for QCEW-trend-based industries

$$N_t = \left(N_{t-1} * \left(\frac{E_t}{E_{t-1}} \right) \right)$$

where:

N = noncovered employment estimate
E = QCEW employment
t = Benchmark year

Table 18. Noncovered industries calculated using QCEW trend [1]

NAICS Code	NAICS Industry Title
511110	Newspaper publishers
511120	Periodical publishers
511130	Book publishers
921140	Executive and legislative offices[2]
922190	Other justice, public order, and safety activities[2]
923110	Administration of education programs[2]
924110	Administration of air and water resource and solid waste management programs[2]
925110	Administration of housing programs[2]
926110	Administration of general economic programs[2]
927110	Space research and technology[2]
928110	National security[2]

[1]Formerly Table D.

(2)Indicates that noncovered employment is calculated only for firms owned by State and local government.

Corporate officers are one of the largest exemptions outside of the industries listed. In several States, corporate officers are exempt from UI coverage and as a result noncovered employment exists in most NAICS industries in those States. Corporate officers and other State specific employment exemptions outside of those listed above are collected from State offices annually by CES.

Noncovered employment industries are reviewed and refined periodically. This review is done to identify any changes in state UI coverage, as well as to ensure that CES captures all exempted employment within the scope of the CES Survey and that our methodology and external data sources are as accurate as possible. When additions and changes are identified during review, they are incorporated with the following March benchmark.

Changing data ratios for Education and Religious organizations. Due to the small sample in Religious organizations (NAICS 8131) and definitional exclusions in the collection of data for Educational services (NAICS 611), certain ratios for these series are recalculated with each benchmark to allow for the creation of aggregate totals. Production or nonsupervisory employee (PE) and women employee (WE) ratios, all employee (AE) average hourly earnings (AHE) and average weekly hours (AWH), and PE AHE and AWH for these series are calculated based on the weighted average of the previous year's Professional and technical services, Education and health services, Leisure and hospitality, and Other services supersectors' annual averages. This year the March 2012 values were set based on the 2011 annual averages.

The Education services series uses the PE ratio, AHE, and AWH calculated from the weighted average. The Religious organizations series uses the PE ratio, WE ratio, AHE, and AWH calculated from the weighted average. In both cases, the ratios, AHE, and AWH for AE and PE are held constant through the next benchmark.

Historical Reconstructions

Beyond the monthly revisions and the benchmark revisions, CES employment, hours, and earnings estimates have been reconstructed several times in order to avoid series breaks and to provide users with continuous, comparable employment time series suitable for economic analysis when incorporating methodological changes. The major reconstruction efforts are briefly described below.

Improvement to seasonal adjustment methodology. With the release of the 1995 benchmark revision (in June 1996), CES refined its seasonal adjustment procedures to control for survey interval variations, sometimes referred to as the 4- versus 5-week effect. This improvement mitigated the effects that a variable number of weeks between surveys had on the measurement

of employment change, thus improving the measurement of true economic trends. At that time, data for 1988 forward were revised to incorporate this new methodology.

CES sample redesign. Over a 4-year period, CES introduced a new probability-based sample design; it replaced an outmoded and less scientific quota sample-based design. The new design was phased in by major industry division with the June 2000 through June 2003 benchmark releases (see Table 19). As each industry was phased in, the post-benchmark estimates for that year were affected by the new sample composition.

Table 19.CES sample redesign phase-in schedule [1]

Year	Industries converted to new sample design
2000	Wholesale trade
2001	Mining, Construction, Manufacturing
2002	Transportation and public utilities; Finance, insurance, and real estate; Retail trade
2003	Services

[1]Formerly "CES Sample Redesign Phase-in Schedule".

Industry reclassification. CES periodically updates the National nonfarm payroll series to revised NAICS structures. This update usually occurs every four to five years. For all NAICS updates, affected series are reconstructed back to at least 1990, and in some cases, where longer histories are available, they are reconstructed back further.

With the release of the 2011 benchmark in February 2012, CES converted from NAICS 2007 to NAICS 2012. The conversion to NAICS 2012 resulted in minor content changes within the Manufacturing and the Retail trade sectors, as well as minor coding changes within the Utilities and the Leisure and hospitality sectors. Several industry titles and descriptions were also updated. Prior to the NAICS 2012 structure, CES estimates were classified under NAICS 2007 system, preceded by the NAICS 2002 system. The NAICS system was updated from NAICS 2002 to NAICS 2007 in early 2008. Before switching to NAICS 2002, the CES estimates were classified under the Standard Industrial Classification (SIC) system. CES estimates were converted from SIC to NAICS 2002 in mid-2003. For more information about NAICS in the CES program, see www.bls.gov/ces/cesnaics.htm.

Other Factors Contributing to Revisions

Over the time period covered by the revision and collection rate tables, CES has introduced many program improvements; some of these affect the revision patterns observed over time.

Monthly revisions. As noted above, the overall magnitude of these revisions has trended down over time mainly due to automated and improved data collection techniques which raised the collection rates for the first and second preliminary estimates. Other factors of note include:

Timing of benchmark revisions. Between 1980 and 2003, annual benchmark revision updates were introduced in June of each year, concurrent with the March final sample-based estimates and the April second preliminary estimates. The monthly revisions for March and April for these years were often larger than for other months, because the March final and April second preliminary estimates were incorporating not only additional sample but also other benchmark-related changes.

Beginning with the 2003 benchmark revision (published in 2004), CES reduced the time required to produce the annual revisions by four months and thus began publishing benchmark revisions in February rather than June. Therefore from 2004 forward, the November final and December second preliminary estimates are affected by benchmark revision updates, rather than the March final and April second preliminary estimates.

Timing of seasonal adjustment updates. Between 1980 and June 1996 seasonal factors were updated on an annual basis along with the benchmark revisions. Thus March final and April second preliminary were affected by the recomputation of seasonal factors as well as other benchmarking procedures and additional sample receipts.

Between November 1996 and November 2002, CES updated seasonal factors on a semi-annual basis, meaning that September final and October second preliminary estimates as well as March final and April second preliminary revisions were affected by seasonal factor updates.

Since June 2003 the CES program has used a concurrent seasonal adjustment procedure, meaning that seasonal adjustment is rerun every month using all available months of estimates including the month currently being estimated for first preliminary. This technique yields the best possible seasonal adjustment for the current month and reduces benchmark revisions to over-the-month changes. In the application of the concurrent procedure, the previous two months are revised to incorporate not only additional sample receipts but also new seasonal factors. Thus there are no longer individual months that are more affected than others by seasonal factor updates. However, this practice does mean that revisions from second preliminary to final sample-based estimates for each month are affected by the CES replacement policy. Because CES revises only two months of estimates each month, the fourth month back from the current first preliminary estimate is adjusted using a different set of seasonal factors than the third month back. For example, with the release of October first preliminary data, factors are revised for September and August, but not July.

Table of Figures

Use the links below to skip to specific equations, tables, and figures describing the CES sample, data collection, available statistics, estimation, and revisions. For a list of changes to figure and table titles, see www.bls.gov/web/empsit/cesnewseries.htm#tabtitles.

Equations

Tables

Figures

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